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Electrical World

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November 17, 1923

Interconnection in New York State

with a map supplement showing interconnected lines and stations in New York and neighboring states

"INTERCONNECTION of electric light and power systems is by no means a merely technical problem. It is an economic and a public policy problem of immediate importance.

"The growth of the electrical industry has been from small individual plants into large systems made up of a number of plants feeding into transmission lines and supplying load widely diversified in territory and character. The same fundamental reasons which have made it necessary to connect several plants in one system together and to replace small, inefficient plants with large plants operating at high economy apply to interconnections between the present systems, whether they be large or small."

The Measurement of High Values of Insulation Resistance

By J. B. Whitehead

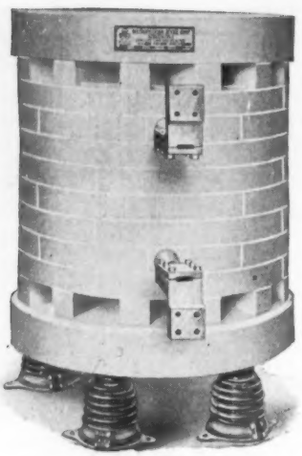
The Properties of Electric Sheet Steel

By. C. H. Willis

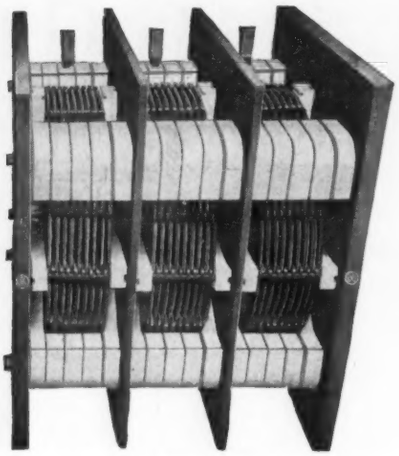
The Experiment in Rural Electric Service in Minnesota

The Latest Generating Station in Great Britain

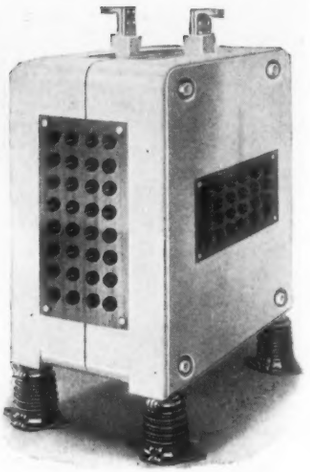
The Barton Station at Leeds



Indoor service
350 to 750 Amp.



Three-phase Feeder Coil



Indoor service 25 to 350 Amp.

Three Real Headliners

When a central station manager is in doubt as to the kind of current limiting reactors to install—it is a good idea to check up what equipment is used by the greatest and most economical generating plants in this country.

Metropolitan Reactors, for instance, are used by the big Edison Companies in New York, Boston, Chicago, Detroit, Brooklyn, etc. Also they are standard equipment not only in the central station but in the industrial field as well.

Short circuits cannot be prevented as yet, but you can do the next best thing, install Metropolitan Reactors and protect your equipment from abnormal and dangerous stresses. Investigate today.

Partial List of Installations of Metropolitan Reactors

Edison Elec. Illuminating Co.	Boston, Mass.	N. Y., N. H. & H. R. R. Co.	West Farms, N. Y.
Brooklyn Rapid Transit Co.	Brooklyn, N. Y.	N. Y. & Queens Elec. Light & Power Co.	Long Island City, N. Y.
Calgary Municipal Electric Co.	Calgary, Canada	Potomac Electric Co.	Washington, D. C.
Canadian Niagara Falls Power Co.	Niagara Falls, Ont.	Public Works Department	Lake Cooleridge, New Zealand
Cataluna Power Co.	Barcelona, Spain	Public Service Electric Co.	Newark, N. J.
Chicago, Lake Shore & South Bend R. R.	Michigan City, Ind.	Shawinigan Hydro Elec. Power Co.	Shawinigan Falls, Ont.
Cohoes Light & Power Corp.	Cohoes, N. Y.	Tennessee Power Co.	Chattanooga, Tenn.
Commonwealth Edison Co.	Chicago, Ill.	Toledo R. R. & Light Co.	Toledo, Ohio
Consolidated Gas & Electric Co.	Baltimore, Md.	Toronto, Power Co.	Niagara Falls, Ont.
Dayton Power & Light Co.	Dayton, Ohio	Turners Falls Power Co.	Turners Falls, Mass.
East Hampton Gas Co.	East Hampton, Mass.	United Electric Lighting Co.	Springfield, Mass.
Edison Electric Illuminating Co.	Brooklyn, N. Y.	United Electric Light & Power Co.	New York, N. Y.
Edison Illuminating Co.	Detroit, Mich.		
El Paso Power & Railroad Co.	El Paso, Texas	Union Gas & Electric Co.	Cincinnati, Ohio
French General Electric Co.	Paris, France	Union Electric Lt. & Pwr. Co.	St. Louis, Mo.
		U. S. Explosive Plant	Nitro, West Va.
Hydro Electric Power Commission	Toronto, Ontario	Utica Gas & Electric Co.	Utica, N. Y.
Havana Elec. Ry. Lt. & Pwr. Co.	Havana, Cuba	Victoria Falls & Transvall P. Co.	Simmerpan, South Africa
Interborough Rapid Transit Co.	New York, N. Y.	Warren & Co.	Boston, Mass.
Joyce Gridland Railroad Co.	London, England	Westchester Lighting Co.	Mount Vernon, N. Y.
Municipal Gas Co.	Albany, N. Y.		
New York Edison Company	New York, N. Y.	Youngstown Sheet & Tube Co.	Youngstown, Ohio

Metropolitan Device Corporation

1250 Atlantic Avenue, Brooklyn, N. Y.

Electrical World

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"Reducing the Labor Content"

THIS striking phrase was used by Gerard Swope the other day to show the potentialities of electricity as an agency for cutting unit costs of production. The first Aldred lecturer thus went straight to the heart of his theme. Indeed, some day the historian of these times will write the record of electricity as the greatest accelerator of production and the most helpful burden bearer introduced by engineers to modern civilization. Even in this early stage of world electrification the results that have been realized from the application of so flexible and economical a form of energy to everyday human toil have caused the industrial conceptions of the most sanguine of electrical engineers to be welcomed not as imaginative visions of what may be generations hence, but as matter-of-fact programs for the near future.

TO REDUCE the amount of human effort required to perform the tasks of the day is one of the highest accomplishments of the engineer, and it is an evidence of advancing intelligence that manual laborers themselves no longer oppose progress in this direction as a menace to them but welcome it as a blessing; for all save the dull have come to see that with the march of invention and the harnessing of Nature's forces come less arduous toil, shorter work hours, greater earnings, and in the long run a reduction in the numbers of those whose employment is intermittent or precarious.

An economic analysis of costs shows labor to be the most striking item in the tabulation. The electrification of industry increases production, lowers the labor content, surrounds the worker with the comfort of improved illumination and places at his hand a better control of processes together with a surer application of power at the proper time and place.

WHETHER labor content is defined as the effort of mankind to achieve a productive result in the home, in the factory, office or store, in the field, forest or on the sea, makes little difference. The all-inclusiveness of electric service as the economic solvent of a costly era challenges the imagination. So long as electricity does the work of the world better, more rapidly, at less unit cost than other agencies, its "place in the sun" is impregnable. To cheapen production without sacrifice of quality is economic victory, and in its ability to cut unit costs without impairing—nay, while improving—the welfare of the worker electricity leads the march of progress upward and onward to ever-widening horizons of service to mankind.

Joseph Sachs

An engineer and inventor of rare versatility who has contributed greatly to the development and exploitation of a wide range of electrical wiring accessories, notably in the field of fuse protective devices.

IT IS natural that the most extended fame in the electrical industry should come to men whose achievements and creations have been spectacular for size and importance. The fact that for one great invention of major class there must be perhaps a hundred smaller inventions providing the foundation details from which the structure must be fabricated is forgotten. Yet men like Joseph Sachs, chief engineer of the Johns-Pratt Company, Hartford, Conn., who have contributed to the development of the materials, fittings and equipment that are vital elements in the electric circuit as perfected today, have displayed a genius of as high an order as the fathers of more conspicuous apparatus. Mr. Sachs has to his credit more than two hundred diversified patents.

Born in New York City in 1870 and educated in the public schools and the College of the City of New York, he began his electrical work with the Sprague Electric Motor Company in New York in 1890, soon afterward joining the Edison Machine Works, now the General Electric Company at Schenectady. He had a distinct inclination for inventions and for the next six years engaged in extensive development work embracing electric railway equipment, fire alarms, signals for railways, electric type-setting machinery, electric metal heating and melting, ore separation, protective devices and switches. He made a study of electric canalboat propulsion, lectured and wrote many articles for technical and popular magazines.

In 1908 Mr. Sachs became associated with the Johns-Pratt Company as consulting and chief engineer, and from that time to this he has devoted himself to the development, manufacture, exploitation and sale of inclosed-fuse protective devices and other electrical accessories based on his own inventions. His work has been extremely versatile. In addition to the fields already mentioned, he has interested himself in electric drive and control for motor vehicles and a wide variety of fittings used in wiring construction, covering almost all the electrical accessory field.

About ten years ago Mr. Sachs began the development of standardized protective electric service equipment. His efforts have borne conspicuous fruit in the recently announced combination of four large manufacturers in the production of a standard service entrance unit.

In 1903 the John Scott medal was awarded to him by the Franklin Institute for pioneer work in fuse protection devices. He is a fellow of the A. I. E. E. and an active worker with the A. M. E. S.

Editorial Comment

Electrical World, November 17, 1923

Volume 82 Number 20

The Brightest Star in the Industrial Firmament

THROUGHOUT the world records show that the industry which is most alive today is the electrical. A greater percentage of workers and equipment is engaged in the production of electrical energy and electrical apparatus and supplies than is employed in other industries. Why? Edison says that it takes ten years to get the public to accept an idea. We have been trying to electrify the world during the last forty years and were making great headway when the war intervened. The seed sown then, however, did not die and is now blossoming forth. In many sections of the country the growth is so intense that the old record of doubling the crop every five years has by intensive cultivation been beaten. Now the crop is doubled in four years, and there are no indications of a dearth. Truly, ours is a productive industry, and if half the ideas promulgated ten years ago bear fruit, there will be great difficulty in harvesting the yield.

Why the Ferris Amendment Was Smashed

WHEN the voters in the most populous commonwealth in the Union carry four amendments to the state constitution by majorities ranging from small to large and simultaneously sink a fifth amendment deeper than ever politician's plummet sounded, it must mean something. Last week such a tidal wave swept over the proposed amendment to New York's organic law designed to permit the use of a very small part of the Forest Preserve for the generation and transmission of electricity. This amendment had the outspoken support of many eminent engineers; it was pretty generally indorsed as a matter of course by electrical men and all professionally interested in power development, and its putative father and other political sponsors did what they could to save it. But all was in vain. The waters wild went o'er their child, and they were left lamenting.

Yet nowhere to a greater degree than in New York are the people alive to the advantages of electrical energy. Nowhere have they a keener sense of the loss inherent in unused water power. Nowhere have they been more assiduously "fed up" on the benefits of superpower. Why, then, the apparently astonishing result? It is unreasonable to attribute it all to the arguments of a few rich estate owners. Since when were American voters so responsive to esthetic appeals obviously tinctured with the suspicious flavor of exclusiveness? Was it not, rather, because the opponents of the amendment at once christened it the "water-power grab" and because, however unjust this name may have been, it stuck like a burr? One might have thought that the charge thus thrown at the supporters of the amendment would have spurred them to a convincing refutation; but no one came forward to demonstrate to reasonable men and women that no "grab" could follow the passage of the amendment. There were only "say so's" in denial and engineering arguments, when the objectors wanted assurances of conservation and proper remuneration to the state.

Why Not an Open Power Policy Openly Arrived At?

IT WILL be two years at least before another amendment can be submitted. Before that shall be done there is ample time to clean up the whole water-power situation in New York. But it must be cleaned up in the open. Cannot power men co-operate with political leaders of standing and integrity to formulate, after full hearings, a state policy, fair to all, which will become as impregnable in New York as the federal policy bids fair to become in the nation at large? If necessary to convince the voters that no sinister motive lurks behind it, the legalistic objection to encumbering the constitution with non-basic law must be disregarded and that instrument must itself provide the answer to the cry of exploitation.

The electrical industry in the state has a great part to play in bringing this clarification about. More important even than the promotion of good public relations between central-station companies and their customers by means of fair and courteous treatment of individuals is the promotion of good public relations between the industry at large and the American electorate by a policy at once so public-spirited and so frank that not even the most prejudiced can believe there is aught concealed.

A Responsibility of Schedule Committees

THIS week again there is more evidence that associated class groups of electrical men still continue to forget that they are elements in a great industry, not independent, isolated organizations with no responsibility to anybody but themselves. The Electrical Supply Jobbers' Association has just held its annual winter convention in Buffalo at the same time that the Electrical Manufacturers' Club met at Hot Springs, Va. Inasmuch as the Electrical Manufacturers' Club is a semi-social organization composed of executives of the electrical manufacturing industry and its meetings are rarely attended by other than members, there are undoubtedly few among the jobbers who would have gone to Hot Springs. It is of very great importance to the electrical industry, however, that the executives among the manufacturers shall attend the conventions of the jobbers, and, normally, there are a fair number of them present; but this year, because of mere lack of care in the arrangement of dates, it was impossible. No one doubts that most misunderstand-

ings are due to lack of contact. Differences of opinion between jobbers and manufacturers and a lack of harmonious policies that goes no little way to introduce costs and troubles into the distribution of electrical products could be materially relieved if the jobber and the manufacturer knew each other better and had a clearer vision of each other's problems. Conventions of these national associations offer opportunities for such contact that are invaluable, and it is a distinct hurt to the electrical industry that committees will continue arranging convention schedules without regard to possible conflicts with other meetings through a lack of appreciation of the industry interests that are involved.

Cheerful Illumination Needed in Autumn

LATE autumn is anything but cheerful. Others besides the poets sometimes find the days both short and melancholy and the atmosphere dank and cold. People remain indoors more, and whether at home, at work, shopping or at play, they rely on artificial illumination to dispel the gloom. That the illumination should be adequate goes without saying. It should in addition impart a warm glow and an atmosphere of cheerfulness. Electric light and power companies can perform an excellent service in educating the public mind to appreciate the inherent domestic and civic advantages of electric lighting. The place to begin is where it is most needed—in the home. A survey there is not only conducive to good will but profitable as well. Besides, every seller should see that the buyer gets a maximum benefit from the product bought. What people need most now is illumination, and electric light companies should make it their business to see that what they sell is very good and as cozy and cheerful as illuminating skill and artistic treatment can make it.

Regional Studies on Interconnection Advance the Day of Accomplishment

AS ANOTHER evidence of the fact that the electric utilities themselves are actively at work to bring to the public the benefits of interconnection, the 1923 report of the transmission lines committee of the Empire State Gas and Electric Association is commendable. But, beyond being a definite indication that some one is at work, it also presents information and ideas which will be found valuable not only in the particular region under study but also wherever the problem is being approached. For this reason the ELECTRICAL WORLD is publishing parts of this report in this and succeeding issues.

This week the general survey of the present interconnection and the practicabilities, problems and advantages of further connection are presented. The map, printed as a supplement, together with the statistical and numerical analyses, represents two years of endeavor on the part of the committee to present a concrete picture of the situation.

That ten million dollars will provide the more important interconnections necessary to a realization of the greater benefits in economy and dependability of service in this region may seem an overstatement to some and an understatement to others. It is surely not an immoderate amount, however, when it is considered that the capital released by such further interconnection is figured at $7,875,000 and the capitalized operating savings at $17,500,000. The definiteness with which these facts are presented should assist materially in encouraging those whose responsibility it is to carry on further interconnection in the state to proceed to a definite conclusion.

The discussion and proposals along other lines than the specific cost and savings in New York State will doubtless draw comment from other sections where further interconnection is a pressing problem. The voltage and frequency recommended, the basis of power interchange agreements, the question of power control are all subjects of vital interest to other sections with which ultimately the region under discussion will be connected. A national policy—at least, a policy of correlating the efforts and results of the various sectional studies—is vital and will not be overlooked by the industry.

Another factor of value in such definite reports as this one made in New York is that there is definite answer provided to politician and public as to exactly what benefits are derivable from "superpower" development. Comprehensive, informative reports like this are the best-known antidote to misinformation.

The Handicap of Insufficient Condensing Water

WATER is vitally essential to any power project. The layman does not always appreciate how valuable it is. Coal to him is the all-important element, whereas a modern power station requires from 600 tons to 1,000 tons of condensing water for every ton of coal burned. This is what determines the choice of site for a superpower station and this is what handicaps many an existing plant. The Barton station at Manchester, England, is a typical example. Excellent in design and equipment, a kilowatt-hour ought to be manufactured in it as cheaply as anywhere, but for want of water it is like a cripple on crutches. The same is true of the new station at Birmingham, England, where water is so scarce that sewage must be utilized. What these interior cities need is adequate outlets to the sea. That has been the salvation of many a nation and will also be the salvation of steam superpower stations. Cooling towers are excellent in their way, but they are stones around the necks of large and efficient power systems.

Making the Weaker Part Interchangeable

IT SEEMS to be rather a trite assertion that a combinational device should be so designed that the parts most subjected to wear or damage will be the ones readily removable and interchangeable. Yet every automobilist who has had trouble with his carburetor or gears has the impression that the whole car has been solidly built around just these parts and that getting at an Egyptian king's inner burial chamber is a child's task as compared with reaching the portion of the car's mechanism for which he is seeking.

In the case of electrical indicating instruments it is usually the pivots and not the jewels that are damaged, and yet ever since our industry has begun it has been the universal practice to mount the pivots permanently in the ends of the shaft and to put the jewels in

removable screws in the frame. This practice necessitates the removal of the complete moving element in case of damage to the bearings. It is welcome information that at least one of the prominent instrument makers has recently reversed the usual construction, so that the armature shaft now carries the jewels and the frame the removable pivots. By keeping a few spare pivots in stock it now becomes a matter of only a few minutes to unscrew an old pivot and to put in a new one, without disturbing the moving element.

Besides being an ingenious solution of an old trouble, this change is a splendid example of at least two instructive general principles, namely (a) that many types of construction accepted as gospel truths are simply unnecessary survivals of old engineering traditions, and (b) that a solution of a trouble is sometimes found in simply interchanging two old parts or functions.

Low-Voltage Releases Protect Against Burn-Outs

MANY electrical distribution systems have occasional heavy peak loads which result in low voltage on heavily loaded industrial feeders. Under these conditions of low voltage, motors equipped with low-voltage releases are better protected than those equipped with no-voltage releases only. The tendency is for the user of the motors to keep them operating as long as possible, and under low-voltage conditions burn-outs may be frequent unless the low-voltage release is provided. Other advantages accompanying the use of low-voltage protection are that the station is benefited by having the load on the system automatically reduced and, on geared applications, breakages are reduced because sudden jars resulting from voltage fluctuations are eliminated.

Use of Electric Light for Stimulating Growth in Plants

THE papers by Professors Harvey and Findlay presented at the last convention of the Illuminating Engineering Society offer an encouraging outlook as to the possible use of electric light in hothouses, plant-breeding establishments, agricultural experiment stations and the like. The assimilation of carbon by plants is increased proportionally to light intensity, so that with the use of intense electric light the growth of plants is much accelerated. The data and photographs given in the two papers leave no doubt about this point.

This new use of electric light deserves careful consideration on the part of power companies and lamp and fixture manufacturers. While by no means a ready business at the present time, it deserves going after in a systematic way. The lights can be used from late at night until early in the morning, thus constituting a steady and desirable off-peak load. Considerable prospective business lies near large cities where there is a steady demand for fancy flowers and vegetables. If these could be raised a few weeks ahead of the regular season, or for special occasions like Easter and Thanksgiving Day, the price that they would command may pay for the cost of the required electrical energy.

It has also been pointed out that the production of new and desirable hybrid varieties of plants can be much helped by the use of electric light, because two existing varieties can be forced to bloom at the same time, and also because the production of male and female flowers in some plants is dependent upon light intensity.

Kindle the Spark —Don't Stamp on It

IN A CERTAIN city, not so long ago, a man of genius in the real estate business developed several squares in a residence neighborhood into a little "Maxfield Parish community" of delightfully artistic homes. Homes, garages and planting all combined to create a most unusual and appealing atmosphere. Naturally there was a stir of public interest. People flocked to see the new homes. The idea came to an electrical man of this community that here was an ideal setting for a "home electrical." Thousands of people were coming to look at this development and would be delighted to inspect one of the homes completely furnished. It might be used as a background for a demonstration of electricity in the home.

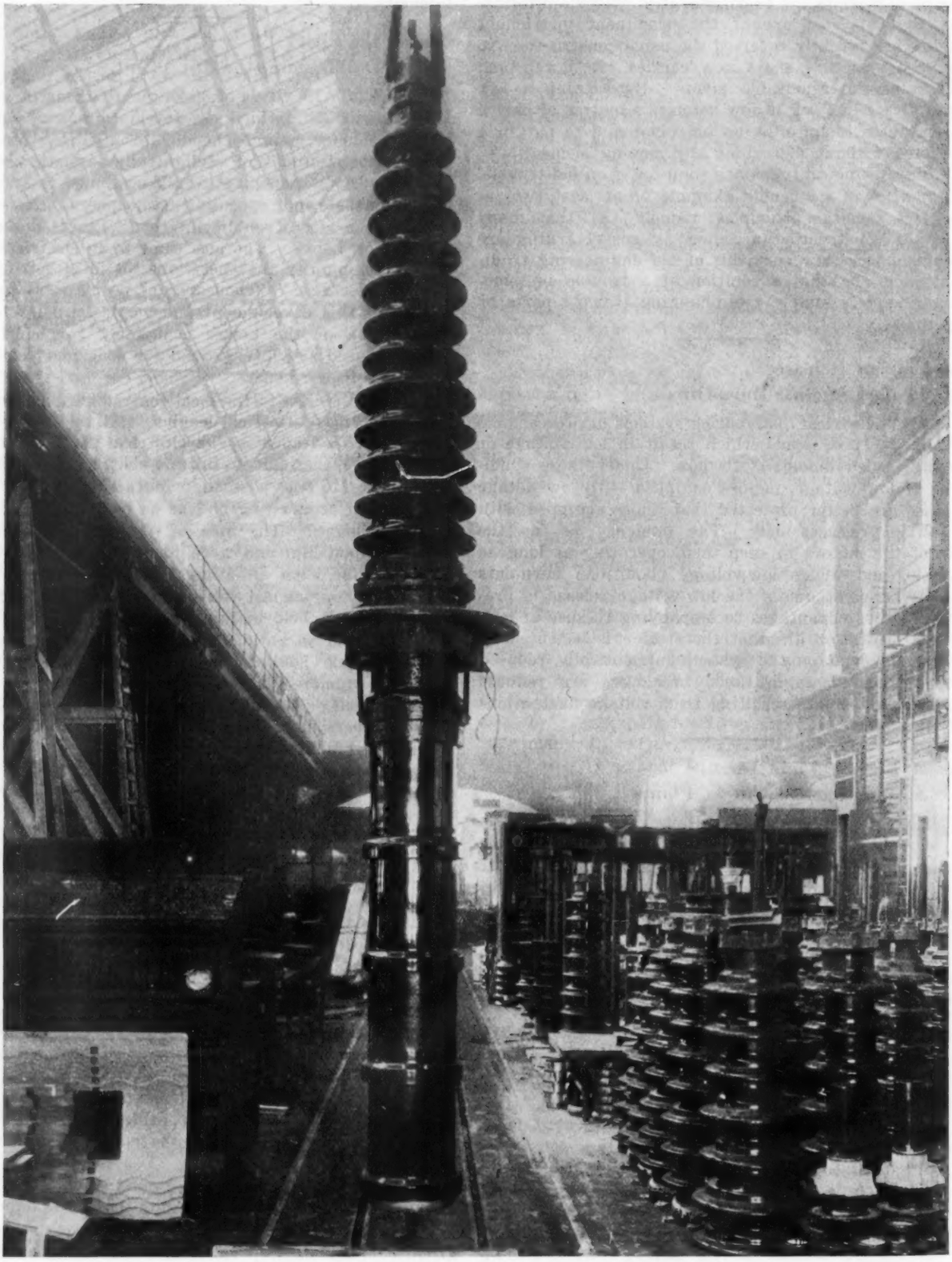
He took the idea to the local central-station company and to the local electrical league. But they were cold. He was not a leader in the electrical family. It was not his place, they felt, to initiate electrical co-operative activities. He was a small manufacturer of a rather unimportant product. Who was he to be organizing an electrical home? The men of the lighting company frowned upon him and were too busy to furnish any appliance for such an affair or to assist him. The electrical league at last voted him money, but its members would not help in this irregular proceeding.

But he was an enthusiastic chap, and when nobody else would take hold and make good this unique opportunity to promote the local electrical industry he went ahead himself. By the most persistent and courageous effort he personally secured the co-operation of individual manufacturers, who furnished and equipped one of these homes as a "home electrical." From the point of view of the charm of the home itself and the ingenuity and skill with which it had been advertised and operated it has been one of the most interesting and successful of these demonstrations ever held. Tens of thousands of people have visited it and been instructed. The house itself was sold for $5,000 more than the similar ones about it. It brought tremendous benefit to the electrical community of the city.

All the industry agrees today that the executive of the central-station company should and must be the father of the local electrical family. He must be the leader if the electrical idea is to be carried enthusiastically forward in that town with the harmonious support of all electrical interests. It is so clear and so obvious a necessity that it seems impossible that little jealousies and red-tape considerations, as in this case, can be allowed to block the path and discourage zeal.

The homes of American cities must be equipped electrically. It is a task that confronts the entire industry. It is committed to it. This is recognized as one of the greatest opportunities and obligations before electrical men today. It is realized, too, that comparatively little progress is being made toward getting this job done, so great is the expansion of the market. Surely, then, the central station should welcome aid from any side and give its hand to any man who comes with a contributing idea and a will to work for the advancement of electrical development.

Mammoth Roof Bushing for 165,000-Volt Circuit



ONE of the largest roof bushings ever manufactured is shown here. It weighs 2,600 lb., has an over-all length of 17 ft. and is designed for a normal voltage of 187,000. It is one of four built by the Westinghouse Electric & Manufacturing Company for the Skagit River development of the city of Seattle. Three will be used for connecting a 165,000-volt bus with a bank of three 10,000-kva., single-phase transformers. The fourth bushing will be held in reserve on the property for use as a spare.

Properties of Electric Sheet Steel

Effect of Chemical Composition, Heat Treatment and Aging on Permeability, Hysteresis, Specific Resistance and Mechanical Properties—Recent Research

By C. H. WILLIS
Johns Hopkins University, Baltimore

A HUNDRED THOUSAND tons of sheet steel was used in the United States in the manufacture of electrical machinery in 1916. This steel cost approximately $7,000,000, and the energy loss due to hysteresis and eddy currents in the product will probably cost an additional $2,900,000 yearly. This statement is based on the assumption that yearly the average loss is 1 watt per pound, that the average daily service is eight hours and that power costs 0.5 cents per kilowatt-hour. This gives some idea of the volume of this business as well as the importance of the magnetic quality of the product.[1]

The magnetic properties of iron are distinctly superior to any other known element. For this reason it was thought for a long while that the best magnetic material obtainable would be the purest iron. However, experiments in recent years have shown that the magnetic qualities of iron alloyed with certain substances may be distinctly superior to those of the purest iron obtainable.

There are a few substances which seem to affect directly the magnetic properties of the iron, such as cobalt and nickel. There are still other substances which are themselves magnetically inert and yet affect the magnetic quality of the iron, such as silicon and aluminum.

The action of the silicon is generally considered to be indirect, and it is probable that the effect of the silicon can be explained by its action on the other more harmful impurities, such as carbon and oxygen, which tend to harden the steel and thereby increase the losses and lower the permeability.

However, there is considerable evidence that certain compounds are formed between the iron and silicon such as FeSi and Fe_2Si, and Yensen finds some suggestion of the compounds $Fe_{19}Si$ and $Fe_{19}Si_2$. It is quite possible that the silicon may affect directly the magnetic properties of these alloys. For instance, some of the alloys of aluminum, manganese and copper are distinctly magnetic, though the elements themselves are apparently non-magnetic. The exact manner in which the silicon acts has not been definitely determined, but it is definitely known that the silicon will prevent the formation of cementite, Fe_3C, and will reduce the iron oxide present. Both the cementite and the iron oxide are very objectionable magnetically as they have a large hysteresis loss and low permeability. Therefore, the magnetic effect of the silicon would seem to be sufficiently explained by these facts[2,3].

One of the most serious defects of early magnetic iron was its aging. Iron which was kept around 100 deg. C. for a few days was found to have an increased hysteresis loss. Sometimes this increase was as much as 100 per cent. This effect caused a serious lowering of the efficiency and thereby lowered the rating and useful life of the apparatus. About 1900 Hadfield discovered that by adding a small amount of silicon this effect was practically eliminated and the addition of 3 per cent silicon would sometimes cause the loss to decrease with time.[1,4]

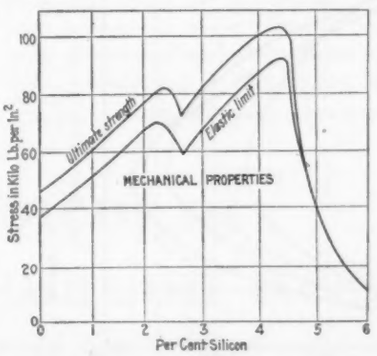


FIG. 1—SILICON CONTENT HAS PECULIAR EFFECT ON ULTIMATE STRENGTH AND ELASTIC LIMIT

However, the silicon not only prevents aging, but it actually reduces the hysteresis loss to about two-thirds that for the pure iron. The curve (Fig. 2) shows the relation between the silicon content and the hysteresis loss as determined by Yensen in his vacuum-furnace tests. This curve shows the optimum result. However, as stated above, the hysteresis loss of high-silicon steel (about 3.5 per cent silicon) is only about two-thirds that for good open-hearth iron.

The permeability at flux densities below 11,000 gausses is increased by the addition of silicon. Above this value the permeability decreases with increasing silicon. For the usual working flux densities around 12,000 gausses the permeability is somewhat reduced. This is a disadvantage as the permeability at working density is the limit in design, but the effect is not serious, because the change in permeability is small for this density. The results obtained by Ruder of the General Electric Company are shown in Fig. 4.

The saturation value also falls off with increased silicon content. This indicates that the silicon acts largely as a foreign substance and diminishes the active cross-section of the iron. This is not usually important in design, for the iron is not frequently worked near saturation. However, for armature teeth

SOME IMPROVEMENTS IN THE MAGNETIC QUALITY OF IRON SINCE 1900

Year	Investigator	Substance	Maximum Permeability	Hysteresis Loss per Cubic Centimeter, per Cycle (B = 15,000 Gausses). Ergs.
1900	Hadfield	Swedish iron	4,000	5,500
1900	Hadfield	2.5 per cent silicon steel	5,100	4,700
1910	Terry	Electrolytic iron	11,000	.....
1914	Yensen	Pure vacuum iron	19,000	1,640
1915	Yensen	0.15 per cent Silicon vacuum iron	66,500	916

[1] T. Spooner, *Electric Journal*, Vol. 14, page 91, March, 1917.
[2] T. S. Fuller, *General Electric Review*, Vol. 20, page 566, 1917.
[3] N. B. Pilling, *Electric Journal*, Vol. 19, page 469, 1916.
[4] W. E. Ruder, *General Electric Review*, Vol. 18, page 197, 1915.

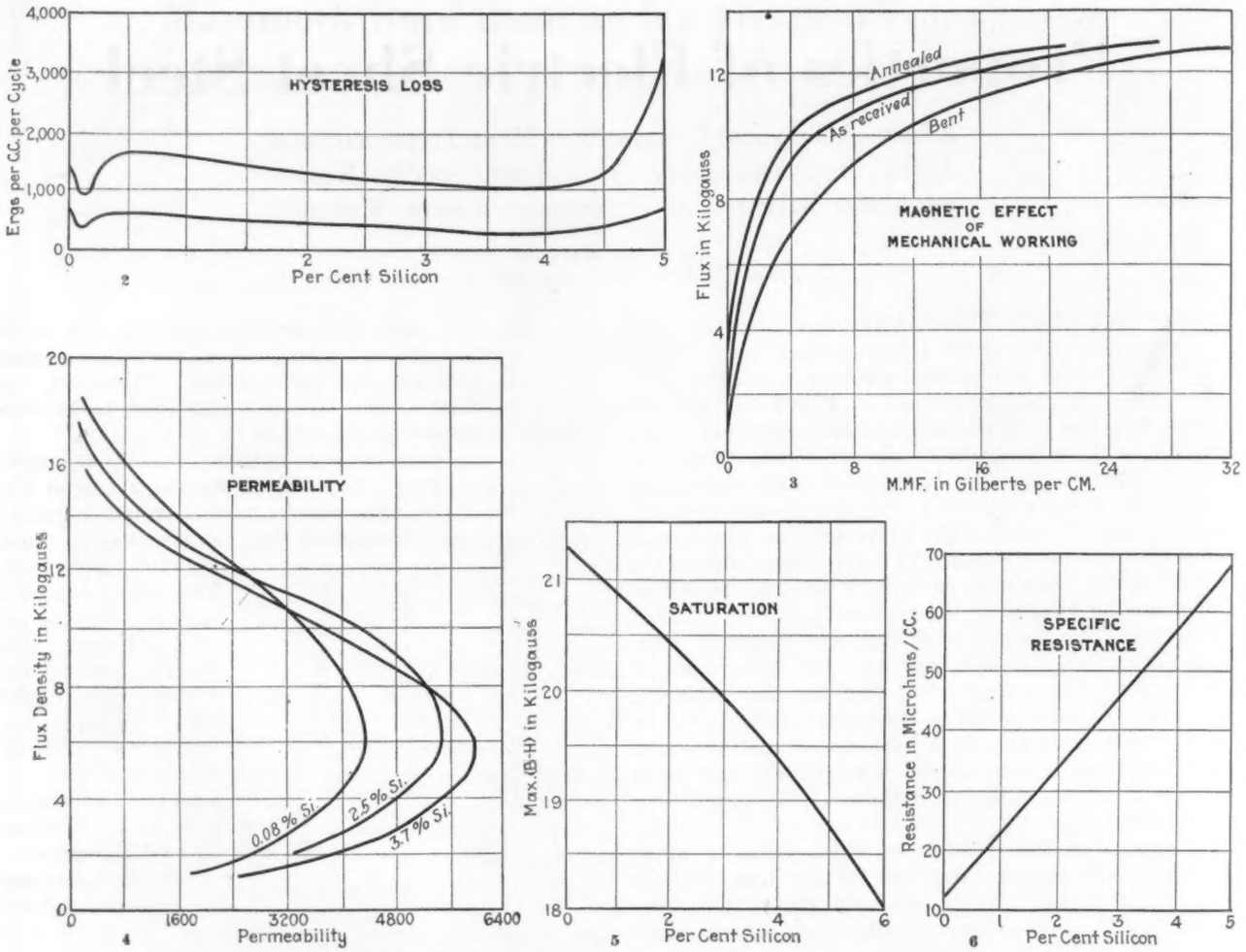


FIG. 2—RELATION BETWEEN SILICON CONTENT AND HYSTERESIS LOSS. FIG. 3—BENDING AND ANNEALING HAVE OPPOSITE EFFECTS ON MAGNETIC PROPERTIES. FIG. 4—SILICON CONTENT INCREASES PERMEABILITY. FIG. 5—SATURATION IN TERMS OF PER CENT SILICON. FIG. 6—SPECIFIC RESISTANCE INCREASES WITH SILICON CONTENT

and similar places it is sometimes a matter of consequence. The results shown in Fig. 5 were obtained by Gumlich[4].

The effect on the electrical resistance is shown in Fig. 6. These results were obtained by Burgess. The eddy-current loss of course decreases with increasing specific resistance, and for this reason the high-silicon steel is used where lowest iron loss is desired[2,5].

The addition of silicon has also a marked effect on the ultimate strength and elastic limit of steel. The results in Fig. 2 were obtained by Yensen in his vacuum-furnace tests. The results on commercial samples give approximately the same results[6]. There is an interesting critical point at 2.56 per cent silicon. Alloys of this approximate composition were not forgeable and sometimes crumbled into crystals from $\frac{1}{8}$ in. to $\frac{1}{4}$ in. across. Yensen suggests that this may be due to the compound $Fe_{19}Si$. Another critical point is found about 5 per cent silicon, which would correspond to $Fe_{19}Si_2$. However, there is not as yet sufficient proof to warrant this conclusion[2].

Along with the increase in strength, however, the steel becomes more brittle. With more than 4 per cent silicon the sheets cannot be sheared satisfactorily as they will crack along the edges of the cut[3,4].

It must be remembered that the curves shown above represent only a fair average of the results on many samples. In commercial steel it is not unusual to find two samples from the same manufacturer and with the same approximate composition one of which will be 100 per cent higher than the other in permeability, and the other qualities may vary accordingly[1].

From the above curves it is seen that the only disadvantage of adding fairly large amounts of silicon, about 3.5 per cent, is the increase in brittleness and lowering of the permeability at working flux density. For these two reasons high-silicon steel is not usually employed for moving machinery, a steel containing less than 1 per cent silicon being preferred. In the manufacture of transformers high-silicon steel is generally used as the losses are more important here. High-silicon steel is also used for induction motors sometimes.

Mr. Spooner of the Westinghouse company gives the following figures as a fair average for these two steels as manufactured commercially[1]:

Silicon Content, Per Cent	Hysteresis Loss per Kilogram (60 Cycles, 10,000 Gausses), Watts	Maximum Permeability	Permeability 16,000 Gausses
Low, 0.0–1.0	2.2	5,000–6,000	500
High, 3.5–4.5	1.3	6,000–7,000	250

All mechanical working, such as rolling, shearing,

[5]C. F. Burgess, *Metallurgical and Chemical Engineering*, Vol. 8, page 131, 1910.

[6]T. D. Yensen, *Bulletin* 83, *University of Illinois*.

punching, hammering and bending, tends to harden the steel. This is attended by an increase in hysteresis loss and a lowering of permeability. In taking magnetic measurements it is also important to remove all stresses such as may be produced by clamping in the permeameter, etc., for these will materially change the magnetic quality of the steel. An idea of the magnitude of this effect may be obtained from Fig. 3.

By annealing the harmful effects of working may be removed. It is for this reason that laminations for transformers, where it is important to have low losses, are always carefully annealed after punching. The first annealing after rolling may decrease the hysteresis loss by 80 per cent and increase the permeability by several hundred per cent.

Since Hadfield's discovery of the superior qualities of silicon steel many other substances have been tried as alloys, but none has been found which will give a product superior to silicon steel for general use. One very interesting alloy of cobalt has been found which has a saturation value about 13 per cent higher than pure iron and a permeability at high flux densities also greater than that for pure iron. Unfortunately, this compound has a low specific resistance; otherwise it would be well suited for use in armature teeth and similar places.

The most interesting work recently undertaken is that by Yensen upon the effect of melting in a vacuum. He has prepared alloys using very pure iron melted and alloyed in a vacuum furnace. By this means he has produced steel with a maximum permeability around 66,500 as compared with 11,000 for the best produced before this. He also finds a hysteresis loss of about one-third that of commercial steel. But there seems little hope of applying the vacuum method to the general manufacture of silicon steel, because of the cost of the vacuum-furnace treatment. However, the vacuum product promises to find application in many special uses, such as current-transformer cores, etc.[6]

For some time there was great interest in electrolytic iron, but the properties of this were not found to be superior to silicon steel for general use. However, by powdering and compressing electrolytic iron it is possible to make a substance having very low iron loss and a fairly constant permeability over a wide range of flux density. These are the properties necessary in the cores of loading coils for telephone lines, and this method of manufacture is now employed. Electrolytic iron is used because it is very brittle before the hydrogen has been driven off and can therefore be easily powdered. After powdering, the hydrogen is removed by heating[7].

[7]B. Speed and G. W. Elmen, *A. I. E. E. Journal*, Vol. 40, page 598.

Measurement of High Values of Insulation Resistance

Increasing Importance of Knowledge of Behavior of Insulation in Cables Leads to Refinements in Methods of Measurements

By J. B. WHITEHEAD

Professor of Electrical Engineering Johns Hopkins University, Baltimore, Md.

IT IS well known that the resistance in ohms or megohms of nearly all classes of insulation used in electrical machinery varies so widely with the conditions of the material and of the test as to make this quantity practically valueless as an indication of the probable performance of the insulation. Measurements of insulation resistance by means of a series-connected voltmeter of known resistance, by the megger and by other types of ohmmeter give results which are of value only in equipment of relatively low voltage rating. In the case of high-voltage machinery such measurements serve merely as indications as to whether the insulation will stand up to the first applications of voltage, but throw little light on its subsequent behavior and life. In fact, it is a difficult matter to prescribe a set of conditions, even for a single type of insulation, in which a definite value of ohmic resistance may be measured with satisfactory uniformity on repetition. The Standardization Rules of the A. I. E. E. carefully avoid both the exact definition of insulation resistance

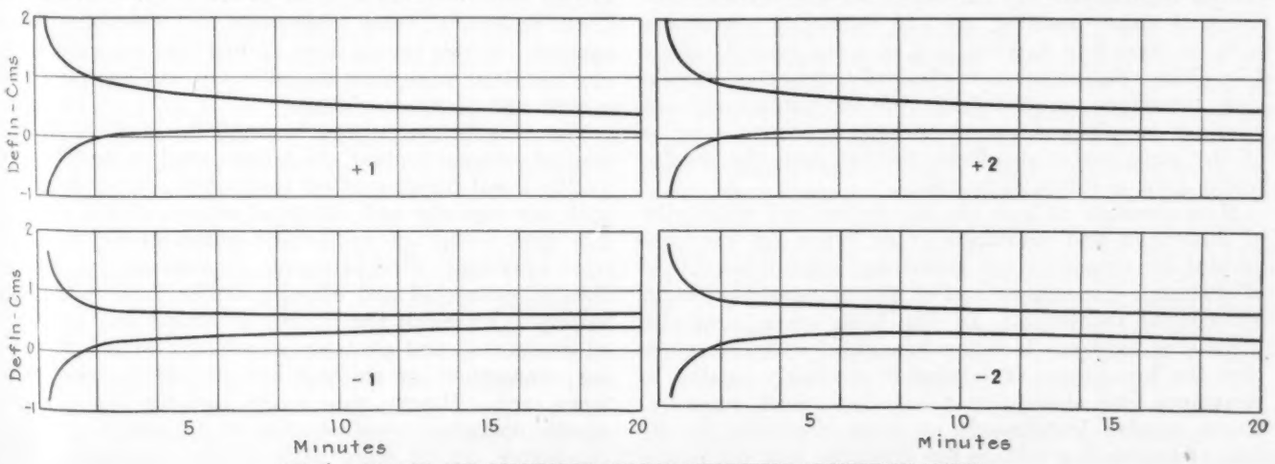


FIG. 1—CHARGE AND DISCHARGE DURING DIELECTRIC ABSORPTION TESTS

and the fixing of conditions for its measurement. In the section on wires and cables the leakage current after a one-minute application of voltage is given as the method for determining the *apparent* resistance of the insulation of a cable, per unit of length, but for the reasons mentioned no more accurate definition or specification is possible.

It is also well known that the explanation of these conditions lies in that property of all types of insulation known as dielectric absorption. When continuous voltage is applied to insulation, the flow of current is at first due to the charging of the electrostatic capacity, but it continues thereafter with decreasing intensity over periods of time relatively short in some cases, but in others extending to an hour or more. The insulation "absorbs" electric charge, and time is required for saturation. On short circuit, time is also required for the complete discharge. This phenomenon suggests a kind of electric viscosity.

Now, theories of dielectric properties, of which there are many, and none of them completely satisfactory, nearly all include the specific resistance of the dielectric as a definite property—subject to variations due to temperature and perhaps other influences, but nevertheless as definite as the specific resistance of conductors. And the total current at any instant after applying continuous voltage is the sum of the decreasing current due to dielectric absorption and the steady current due to the conductivity. Thus since the absorption current continually decreases and approaches zero after a time, the true conductivity or insulation resistance may be measured by reading the steady current at known voltage after the current has reached a constant value; that is, after the absorption current has died out. Unfortunately, however, the time required for the current to reach a steady state varies widely with different materials and in some cases is several hours. Figs. 1 and 2 show typical curves of the variation of current with time following the application of voltage. Both sets were taken on built-up flexible insulations, such as are used on machine windings and are composed of fibrous materials and mica. The curves of Fig. 2 pertain to a sample having a relatively small amount of mica and just manufactured; those of Fig. 1 pertain to a sample having a large amount of mica and after operation for some time under voltage and temperature. Comparing the curves for 1,200 volts and 1,160 volts, it will be seen that in Fig. 2 the current is still decreasing steadily after fifteen minutes, while in Fig. 1 the rate of decrease is extremely small after two minutes. Comparing further the current after one minute with the final steady reading, we find in Fig. 2 a probable ratio of from 5 to 6, while in Fig. 1 the value is about 1.7. Thus the common method of comparing insulation resistance on the basis of one-minute current readings is valueless, except perhaps as among samples of the same material. Even in that case the results would give a comparison only.

Measurements of both the absorption and resistivity of dielectrics and insulation of all types are very important for extending our knowledge both of the nature of dielectric phenomena and of the processes active in commercial insulation. In the latter case especially increasing evidence is being brought forward to show that the breakdown of insulation is closely related to resistance and absorption properties. Such measurements require instruments of great precision, in the case of alternating voltage for dielectric loss and power factor, and in the case of continuous voltage for current. This article is written principally to describe a difficulty encountered in measuring some of the higher values of resistance of commercial insulation, values from 100,000 megohms to 500,000 megohms. Samples of such insulation are often in the form of lengths of cable, assembled armature coils, and so possess considerable electrostatic capacity. If their resistance is relatively low and the absorption high, by spending sufficient time both absorption and resistance may be studied without trouble by the arrangement shown in Fig. 3. In the experiments referred to the galvanometer was of D'Arsonval type and had a sensitivity of 2×10^{-10} amp. per millimeter of scale. In the case of high resistance, measured after the dying out of the absorption current, the readings of the galvanometer

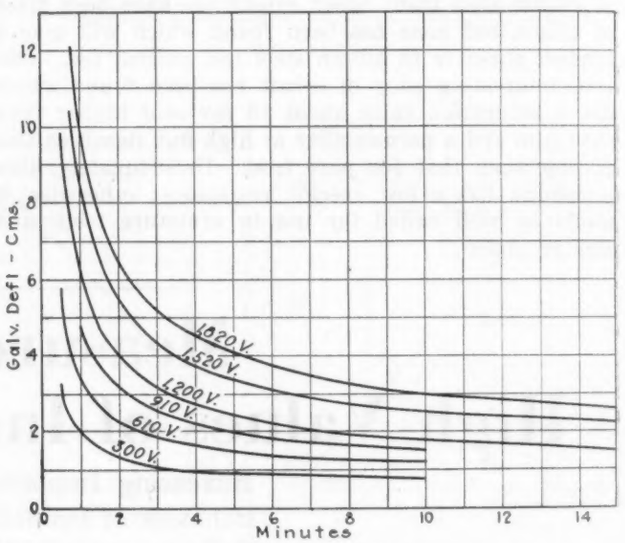


FIG. 2—INFLUENCE OF FOREGOING CONDITION ON DIELECTRIC ABSORPTION

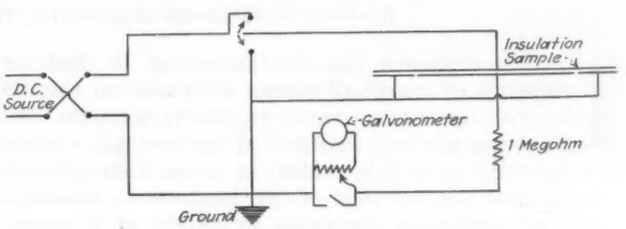


FIG. 3—ARRANGEMENTS FOR MAKING DIELECTRIC ABSORPTION TESTS

at full sensitivity were often of the order of 1 cm. or 2 cm. or less, at from 1,000 volts to 2,000 volts direct current. In this region it was found that the galvanometer readings were very unstable, the oscillations being erratic and at times violent.

The trouble was traced to small fluctuations in the applied voltage, fluctuations far too small to be detected by the usual direct-reading instrument, in conjunction with the capacity and absorbed charge of the sample. The first source of continuous potential consisted of two 1,800-volt direct-current generators in series, directly connected and directly driven from a storage battery. Although the utmost attention was given to all mechanical and electrical conditions, including various connections of shunted capacity and series reactance, and although apparently perfectly smooth and steady operation resulted, the conditions in the galvanometer circuit were little if any improved. The

generators were then abandoned, and rectified alternating voltage was tried. A directly driven 250-volt, 3,000-cycle generator was used, its voltage stepped up and rectified by a "kenotron," or hot cathode vacuum tube, and the output circuit provided with shunted capacity in the well-known manner. This arrangement under careful attention gave some improvement, but far from satisfactory conditions for observation. The operation of each of these sources of continuous potential was apparently perfect, as judged by ordinary tests, and, in fact, the galvanometer reading was the only indication of unstable conditions. There was, therefore, some doubt as to whether the trouble was in the source of potential or in the insulation itself. The samples were found to have values of electrostatic capacity in the neighborhood of 5×10^{-4} microfarads. The effect of a fluctuation of direct-current voltage may be estimated in terms of the change of charge of the capacity, the time involved in the change, the resulting equivalent current, and hence its effect on the instrument. Thus a fluctuation of 1 per cent in an impressed voltage of 1,000 volts, occurring in one-half second, would hardly be perceptible on a direct-reading instrument. Yet such a fluctuation would cause an oscillation of charge due to capacity alone equivalent to a current of 10^{-8} amp., or fifty divisions of galvanometer scale. It was fairly evident, then, that for the high values of resistance to be studied some other source of continuous potential would have to be used.

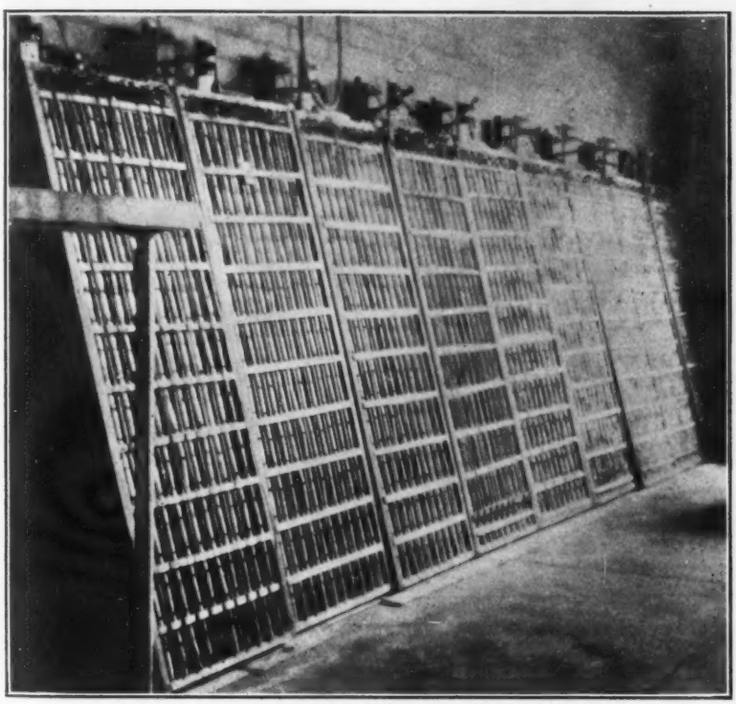


FIG. 4—HIGH CONTINUOUS CURRENT POTENTIAL OBTAINED FROM 2,000 RADIO PLATE BATTERIES

Both primary and secondary (i.e., storage) batteries have often been used for obtaining a constant and steady value of continuous voltage. By reason of their short life the use of primary batteries is usually restricted to relatively low values, say up to 250 or perhaps 500 volts. As to storage batteries, every well-equipped experimental laboratory has probably been through the experience of constructing a storage battery for high voltage. In fact, small-capacity cells assembled in groups for this purpose can be had on the market. The writer's own experience with a 9,000-volt battery of this character has been that unless the battery receives almost daily attention it deteriorates rapidly by sulphation and is expensive and troublesome unless constantly in service. In the present instance the battery referred to was not available for this particular research work.

RADIO PLATE BATTERIES GIVE MOST SUITABLE POTENTIAL SOURCE

Experiments on insulation at high values of continuous voltage have been rare, and there is some evidence that there are important changes in the normal properties as the voltage is raised. For a series of preliminary experiments it was determined to work up to at least 3,000 volts. Both the storage battery and the ordinary 8-in. dry battery were found to mount considerably in price, and so attention was turned to the small dry cells used for the plate batteries in radio work. Even these at the lowest marked rate cost about $5 per 100 volts. However, the interest of a well-known manufacturer was engaged, and 2,000 individual cells slightly defective in manufacture were obtained at a cost of about $50. These cells had a guaranteed life of one year. They were assembled in vertical columns of twenty cells each, and ten of these columns were mounted side by side, separated by wooden strips, in a shallow wooden rack set up on one end. The bottom of the tray and the sides of the vertical columns were lined with sheet fiber impregnated with paraffin. Ten such racks were required for the 2,000 cells. They rested on the floor, tilted slightly backward from the vertical, leaning against a side wall and being insulated from each by porcelain wiring cleats. In this position the weight of each column was used to assist the contact between the positive and negative terminals of adjacent cells. Sucessive columns were connected in series by soldered connecting wires, and a simple arrangement of switches, two bus lines and two flexible cables with spring-clip contacts permitted rapid adjustment for any voltage and also reversal of polarity. A photograph of a part of the complete set-up of the 2,000 radio plate batteries is shown in Fig. 4.

The battery gave excellent results from the beginning. The only difficulty encountered was with poor contact between some of the topmost cells. This was remedied by compressing each column with spiral springs or wedges between the topmost cell and the upper end of the wooden frame. This in turn necessitated crosswise wooden retaining strips to prevent the whole column of cells from buckling outward. With this done, however, no further trouble was encountered. Galvanometer deflections down to 1 mm. or 2 mm., at the highest voltages, were perfectly steady. Naturally, after a few months individual cells begin to fail, and the life of the whole is not much longer. But the cost of replacement is not high for important research, and for measurements of the character mentioned such a battery appears to possess electrical advantages equaled only by the storage battery, and in many cases to be preferred to the latter on the basis of maintenance and upkeep.

England's Latest Generating Station

Features of the Barton Station of the Manchester Corporation Electricity Department—It Is of the Superpower Type Sanctioned by Great Britain's Electricity Commission and Is Typical of Modern English Steam-Station Practice

(This is another article secured as a result of W. H. Onken's trip to and through Europe this summer.)

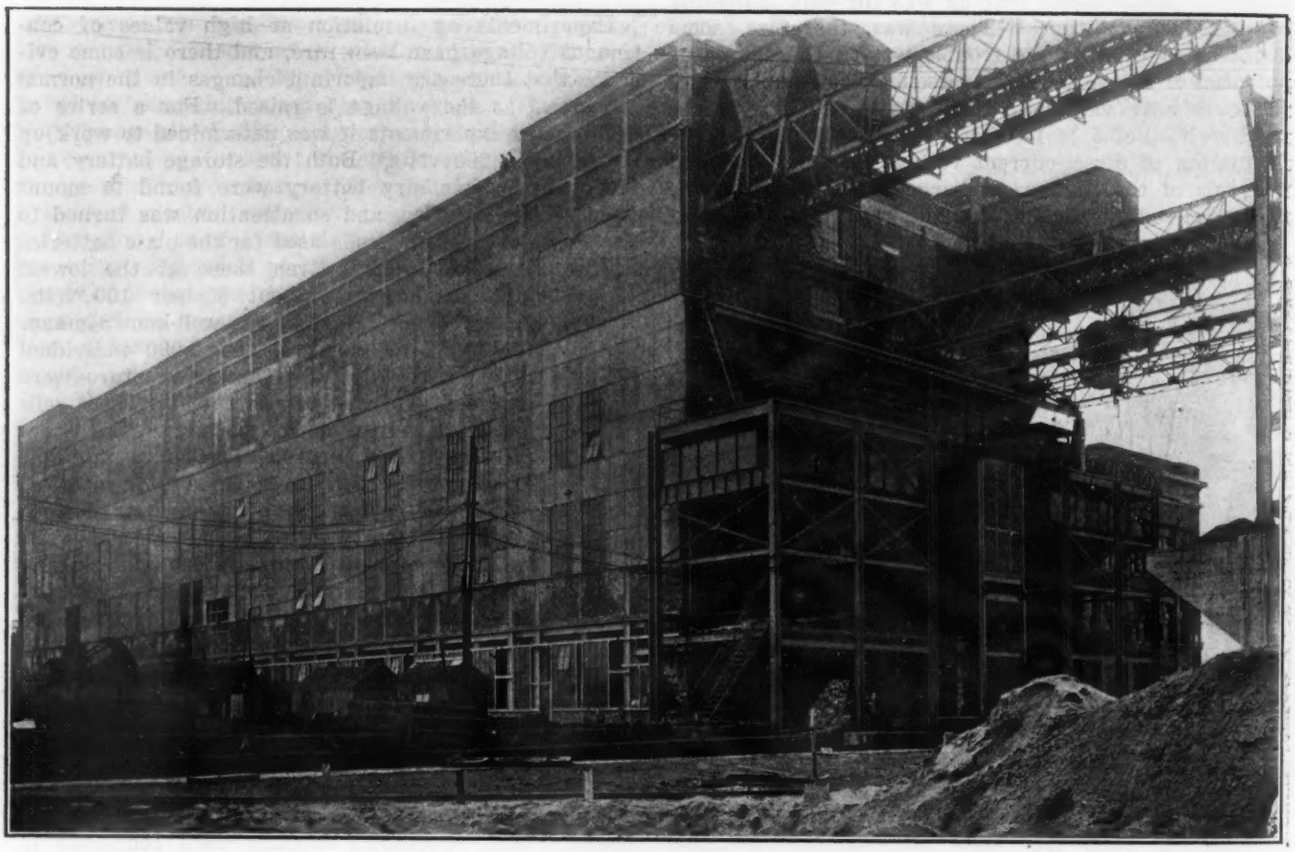


FIG. 1—COAL FROM BARGES IS REMOVED BY TWO OVERHEAD TRAVELING CRANES CARRIED ON A GANTRY 63 FT. ABOVE WATER LEVEL AND DISCHARGED INTO TWO WEIGHING HOPPERS OR TO STORAGE HOPPERS

THE new electric generating station of the Manchester (England) Corporation Electricity Department, which was formally dedicated a few weeks ago, represents the last word in English large modern power-station design and hence has attracted considerable attention. While the site at Barton, Trafford Park, is capable of accommodating 150,000 kw. of plant, there is no certainty that more than 75,000 kw. of equipment will ever be installed owing to limitations of condensing-water supply.

The present plant of 75,000 kw. obtains condensing water from the Manchester Ship Canal, and permission to utilize the water was obtained with difficulty. Should further abstraction of water not be allowed, sewage and subsoil water will have to be utilized, or a different site chosen for another power station. The new station and the work complementary thereto were designed by and the erection carried out under the supervision of S. L. Pearce, the chief engineer of the Manchester Corporation Electricity Department.

The station abuts Bridgewater Canal, over which coal may be brought from the West Lancashire coal fields, and a siding from the Trafford Park railways also permits direct rail communication for coal supply with the principal railway systems of the country. Storage is provided for 26,000 tons of coal, of which 3,500 tons are deposited in the boiler-house bunkers. Water-borne coal is removed from boat by two overhead traveling cranes carried on a gantry 63 ft. above the water level and discharged into two hoppers which feed automatic weighing machines situated outside the eastern end of the boiler house before it passes to the boiler-house bunker conveyors. If desirable, water-borne fuel can also be discharged into reinforced-concrete hoppers cantilevered out on the face of the dock wall and then fed onto the main conveyors for distribution on the storage ground.

Rail-borne coal is delivered to the station over a three-track coal viaduct, one track passing over the weighing machine and connecting with the full siding, and the remaining two passing over the unloading hoppers and also connecting with the railroad siding. The cars are unloaded by tippers of the cradle type, placed between the rails over the hoppers, the latter discharging at the bottom through a filler into the main distributing conveyors, which are of the gravity bucket

FIG. 2—NINE B. & W. DOUBLED-FIRED MARINE-TYPE BOILERS, OPERATING AT 375 LB. AND 738 DEG., ARE EQUIPPED WITH ECONOMIZERS AND AIR HEATERS

Normal rating is 100,000 lb. of water evaporated per hour per boiler. Chain-grate stokers are used.

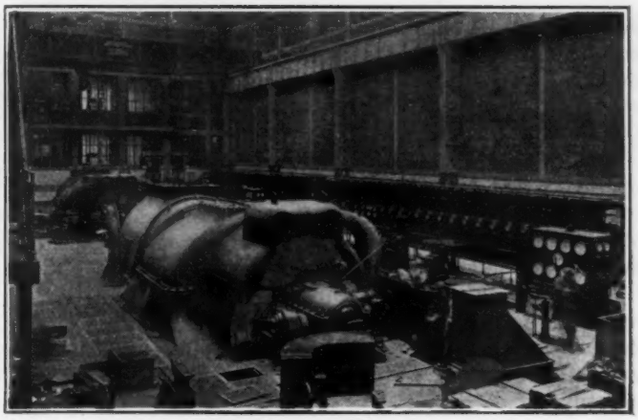


FIG. 3—THREE RATEAU IMPULSE TURBINES ARE EACH RATED AT 27,500 KW., AT 0.8 POWER FACTOR, 1,500 R.P.M., AT A POTENTIAL OF 6,600 VOLTS

Multiple exhausts and bleeder heating are used. Each turbine has fourteen stages and fifteen wheels.

type. Ashes and clinkers are directly removed from the hoppers at the back of the boilers, either by railroad or industrial railway cars running on tracks in the basement of the boiler room at ground level.

Boiler Plant

The boiler plant of the Barton station is of considerable interest, containing as it does nine of the largest boilers in use in Great Britain. The units are of the double-fired B. & W. marine type and are fitted with both economizers and air-heating arrangements. There are nine boilers installed, and each of them is capable of evaporating 100,000 lb. of water per hour, actual, at its most efficient rating when supplied with fuel having a calorific value of not less than 10,500 B.t.u. During overload periods the boilers may be driven to evaporate 120,000 lb. of water per hour, actual, so that the total evaporative capacity for the station is slightly more than 1,000,000 lb. of water per hour.

Each steam-raising unit is complete in itself and consists of the boiler proper, superposed steam-tube economizer, integral superheater, air heater, chain-grate stokers, mechanically forced and induced draft plant, and a steel chimney—the latter being 9 ft. in diameter with a height of 100 ft. to the top from the firing-floor level. A grit arrester has been installed in connection with each chimney.

The plant is designed to operate at a working steam pressure of 375 lb. per square inch, and the superheaters are capable of imparting a temperature to the steam of 296 deg. F., making a final steam temperature of 738 deg. F. at the boiler stop valve. The boilers, which are fired from each end, are designed so that either coal or coke or other fuel may be burned separately or together in the furnaces. To assist the operating staff to obtain the best efficiency from the plant, a liberal provision of steam instruments is provided.

Turbine Installation

The present installation in the turbine room consists of three steam turbines of the Rateau impulse type, coupled to three-phase alternators, capable of delivering a maximum continuous output of 27,500 kw. at a power factor of 0.8. The turbines run at a speed of 1,500 r.p.m., and each is designed to develop at its most economical rating, the power corresponding to an output of 25,000 kw. and to carry for short periods a maximum load of 31,250 kw.

The normal conditions for which the turbines are designed are as follows: Steam pressure at turbine stop valve, 350 lb. per square inch gage; total temperature of steam and turbine stop valve, 700 deg. F.; vacuum at turbine exhaust at normal full load, 29.1 in.

One of the chief points of interest is the construction of the exhaust end of the machine, which is arranged on the now well-known multi-exhaust principle. The turbine has fourteen stages and fifteen wheels, the fourteenth stage having two exhaust outlets from which the steam is directed in a stream-line path to the condenser. The size of the exhaust opening is 8 ft. x 16 ft.

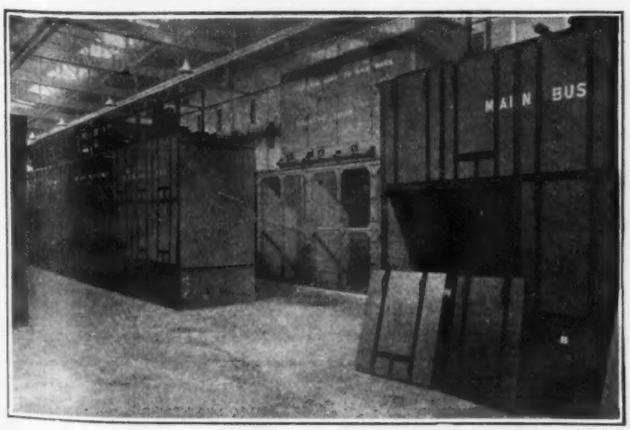


FIG. 4—SWITCHING IS DONE AT 33,000 VOLTS

The 6,600-volt generators are connected directly to their respective transformers through link switches only.

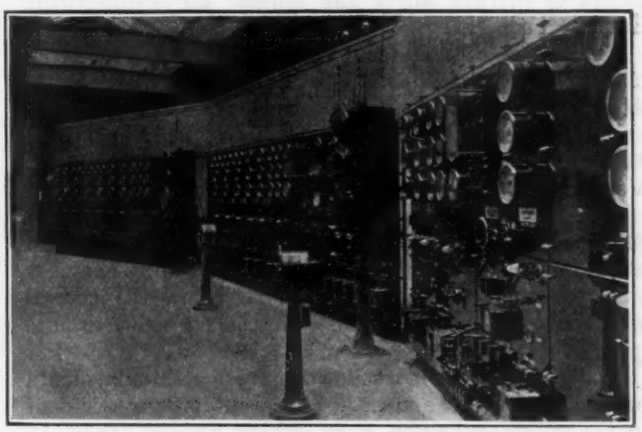


FIG. 5—VIEW OF SWITCHBOARD AND CONTROL ROOM

Six feeders are now supplying energy to the Manchester area, with two feeders soon to be added.

A bleeder feed-water heater forms a part of the turbine equipment, being inclosed in a compartment which extends across the turbine casing. The heater is exposed to steam drawn from one of the latter stages of the turbine.

The main alternators are designed on standard lines operating at 6,600 volts. Each machine is ventilated on the closed-air-circuit principle, cooling water being obtained from the main condenser circulating-water system, at the rate of 70,000 gal. per hour.

The main condensing plants are each designed for maintaining a vacuum of 29.1 in. when dealing with 240,000 lb. of steam per hour and supplied with 40,000 gal. of circulating water per minute at an inlet temperature of 55 deg. F.

They each have a cooling surface of 40,000 sq.ft. with tube lengths of 19 ft. 6 in., the tubes being 1 in. in diameter of Admiralty mixture and 18 standard wire gage thick, and two water passes. The condenser shell is built of riveted and welded mild-steel plates with cast-iron waterheads and mild-steel doors.

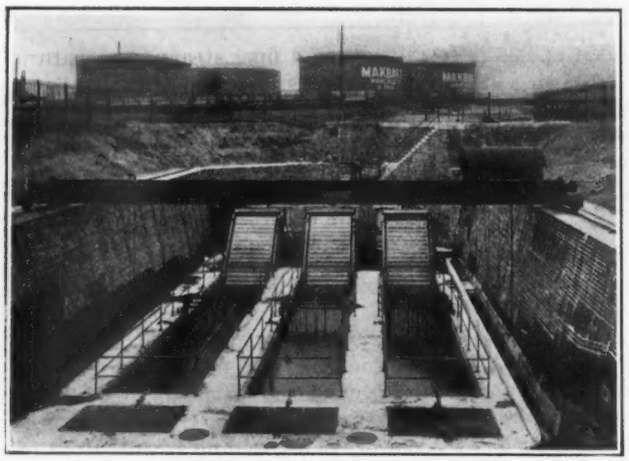


FIG. 4—CIRCULATING WATER IS TAKEN FROM THE MANCHESTER SHIP CANAL IN AN INTAKE AND SCREENING CHAMBER 26 FT. BELOW THE NORMAL CANAL WATER LEVEL

Inclined grid screens and traveling-band screens are placed at the entrance of the three water canals.

The air-extracting plant is in duplicate, one unit being a kinetic rotary plant fitted with two steam jets in series, in addition to the water jet. The second unit is a steam ejector air pump of the three-stage type. Both plants are cross-connected so that they can be run singly or operated together. Each plant has a considerable margin above the normal air withdrawing capacity required.

The whole of the feed system is arranged on the closed-circuit principle. The condensate after withdrawal from the main condenser passes successively through the jet heaters, the main turbine bleeder heaters, the house-service turbine heaters and the Venturi meters to the boiler-feed pump suction.

The circulating water is taken from an inlet in the Manchester Ship Canal and is discharged at a point about 600 yd. below. The intake and screening chamber was excavated to a depth of 26 ft. below the normal water level of the canal and about 50 ft. below ground level.

The water thus obtained will have a minimum depth of 11 ft. in the chamber in the event of any accident to the gates at Barton locks, which have a lift of 15 feet. The water is drawn through three canals, fitted with inclined grid screens and traveling-band screens. Six electrically driven pumps have been installed in the pump chamber below the turbine house, and each pump is capable of delivering 20,000 gal. of water per minute against a total head of 37.5 ft.

After passing through the condensers, the water is discharged into vertical wells in the floor of the turbine-room basement, which communicate with the outlet culvert. A midrib or weir wall extends the whole length of the chamber over which the water passes previous to returning to the canal, the discharge being made by ten openings at the bottom of the outer wall. The wall serves to distribute the flow along the whole length of the chamber and also serves as a measuring weir.

In the switch house are the main step-up transformers, wherein the voltage of generation is raised to 33,000. The middle section of the ground floor is occupied by the pressure-testing outfit, the main transformer oil-circulating pumps and water coolers and the neutral earthing resistances. The first floor of the switch house contains the main and auxiliary busbars, isolating switches, current and potential transformers, etc., while on the second or top floor are all the oil switches and reactors.

The whole of the switching is done at the full busbar pressure of 33,000 volts. No switchgear is interposed between the 6,600-volt and 33,000-volt circuits, as the generators are connected directly to their respective transformers through link switches only.

At the present time four feeders have been laid for transmitting the Barton 33,000-volt supply into the Manchester area. In addition, the Lancashire Electric Power Compny, which has entered into an agreement with the Manchester Corporation for a bulk supply delivered at the Barton bus-bars, has provided two feeders for its requirements. Two additional feeders will be provided by the Stretford Urban District Council for a similar bulk supply arrangement.

For receiving and transforming the Barton supply, the following distributing stations have been erected in the Manchester area: Stuart Street, Oldham Road, High Street (Chorlton-on-Medlock), Moss Side and Dickinson Street. The High Street station is the first complete outdoor substation operating at 33,000 volts in England.

Arizona Reports Large Central-Station Growth

The United States Census Bureau has just issued the following data on the central stations in Arizona:

	1922	1917	Per Cent* of Increase, 1917–1922
Number of establishments	31	29	.....
Commercial	27	25	.....
Municipal	4	4	.....
Income	$3,974,000	$2,141,000	85.5
Electric service	$3,917,000	$2,103,000	87.6
All other	$57,000	$38,000	50.0
Total expenses, including salaries and wages	$3,170,000	$1,752,000	80.9
Number of persons employed	608	436	39.4
Salaries and wages	$861,000	$451,000	90.9
Total horsepower of prime movers	71,922	38,662	86.0
Steam engines and turbines:			
Number	29	28	.....
Horsepower	22,029	23,870	—7.7
Internal-combustion engines:			
Number	28	15	.....
Horsepower	11,862	3,592	230.2
Waterwheels and turbines:			
Number	23	4	.....
Horsepower	38,031	11,200	239.6
Kilowatt capacity of generators	48,765	26,972	80.8
Output of stations, kw.-hr.	147,370,000	65,732,000	124.2
Number of consumers' meters in service	48,231	24,303	98.5
Number of customers	38,134	24,320	56.8

* A minus sign (—) denotes decrease; percentages not shown where base is less than 100.

Interconnection in New York State*

Study of Proposed Intercompany Network Designed to Give Largest Power Pool in America—Itemization of Savings, Operating Procedure and Control — Recommendation for Immediate Development

INTERCONNECTION of electric light and power systems is by no means a merely technical problem. It is an economic and a public policy problem of immediate importance. It has an important bearing on the question of state policy regarding water-power development and the regulation of electric utilities. The transmission lines committee believes, therefore, that the comprehensive study of the New York State situation which it has just completed has been most timely, and that its findings are worthy of careful consideration by the association and by its individual member companies.

The growth of the electrical industry has been from small individual plants into large systems made up of a number of plants feeding into transmission lines and supplying loads widely diversified in territory and character. The same fundamental reasons which have made it necessary to connect several plants in one system together and to replace small, inefficient plants with large plants operating at high economy apply to interconnections between the present systems, whether they be large or small. Interconnections between large systems have been working in some sections to a large extent for a number of years, and the advantages obtained have proved to be very large. The further advantages to be gained by still greater interconnection are apparently greater than those which have been obtained up to the present.

OUTLINE OF ADVANTAGES

Interconnections between the major companies throughout New York State will permit the following:

1. The loading of hydro-electric plants without pondage to full capacity at all times, thus conserving waste water in the normal light load period.

2. The hydro-electric plants with storage to store up water when the stream-flow plants are able to carry the load, so that the storage plants can carry greater loads during the heavy load hours.

3. The saving of waste power and relief to other companies by taking advantage of the diversity of water flow on different watersheds, particularly at the time of the early spring floods.

4. Relieving the load on steam plants to a large extent during the high-water period, thus making a direct saving in coal consumption. A further large economy can be effected by balancing the load and hours of load between hydro plants and steam plants, so that the steam plants will be run at economical loads when they are in operation.

5. The large and efficient steam plants to operate on base loads, thus requiring the use of the inefficient steam plants for short time peaks only or for short periods in the year. This in itself will make a large reduction in the coal consumption.

6. The present equipment to carry greater loads owing to diversity in loads on different systems.

7. Duplicate service in many instances, permitting restoration of service after trouble in plants or on other lines.

8. The amount of equipment necessary to carry in reserve against emergencies to be materially reduced.

9. The building up of a new plant to full capacity with large and efficient units at the time of initial installation, with a material reduction in the investment cost per kilowatt, and in carrying charges per kilowatt, owing to the fact that the interconnected system will supply sufficient load for the entire plant.

10. The postponement by some companies (by taking advantage of the situation mentioned in paragraph 9) of the development of a new plant, thus conserving capital charges.

The committee finds that interconnection in New York State, to an extent which is entirely practical, would, if lines and equipment were installed, permit the following:

In 1923, the release of 60,000 kw. of the present reserve capacity for carrying load. This represents the release of $7,875,000 in capital invested.

In 1933, a saving in installed capacity of 237,000 kw., representing a plant investment of $37,125,000.

The largest part of the generating capacity in the state is in the metropolitan district and in the Niagara district. A study of the relation of these two groups to the state as a whole, together with interconnections between other companies throughout the state, shows that approximately 40 per cent of the total generating capacity in the state would be affected by general interconnection.

If a portion of the money which normally is spent for generating plants be put into lines and equipment for interconnection, a much greater return may be made on the investment, as is explained below.

It is estimated that the energy generated by hydro-electric plants in the State of New York, with the exception of Niagara and St. Lawrence plants, will amount to 1,250,000,000 kw.-hr. in 1923; also that 250,000,000 kw.-hr. could be developed and disposed of as surplus hydro-electric energy.

It is estimated that 500,000,000 kw.-hr. will be generated by steam outside of the metropolitan district in 1923, and that 100,000,000 kw.-hr. of this steam energy will be developed from low-efficiency plants or from good plants operating at low load factor.

It is assumed that the 250,000,000 kw.-hr. of hydro-electricity is salable at 0.5 cent per kilowatt-hour and that the 100,000,000 kw.-hr. of steam energy would cost 0.5 cent less if generated in high-efficiency steam plants operating at high load factor. We have, therefore, 350,000,000 kw.-hr. at 0.5 cent, making $1,750,000 which could be saved or earned in 1923 by interconnection and efficient use of plants, leaving out the Niagara,

*Abstract of transmission lines committee report, convention of Empire State Gas and Electric Association, Lake Placid, N. Y., Oct. 8-9, 1923.

St. Lawrence and metropolitan groups. This amount, capitalized at 10 per cent, would justify an investment of $17,500,000.

The saving in coal would amount to 137,500 tons, which, at $6 per ton delivered, will be $825,000 saved in coal bills. This is based on the estimate that an average of 2¾ lb. of coal is consumed per kilowatt-hour under present conditions.

On a basis of the capital released, $7,875,000, and the capitalized operating savings, $17,500,000, an investment of $25,375,000 would be justified. If less than one-half of this one-year saving, or $10,000,000, be spent, it will provide all the more important interconnections.

The latest study shows a diversity in peaks in the up-state section of New York of approximately 29 per cent and the combined generating capacity to be greater than the simultaneous peak by 63 per cent. This figure of 63 per cent, however, includes a large amount of steam equipment installed to carry load during low-water periods, and it does not represent correctly the capacity which would be available for interconnected loads during the low-water periods.

The steam stations in the metropolitan district have a large reserve capacity, except during their lighting peaks. This excess capacity could be made available to other companies in the state for the greater part of the time that the up-state companies require steam capacity. The low-water period in the hydro-electric plants does not normally come at the time of the year when the metropolitan lighting peak is on, and even at the season of the metropolitan peak the actual duration of the peak load is not a large proportion of the total time. Therefore the metropolitan steam stations could supply a very appreciable part of the steam-power requirements of the up-state companies. By means of load displacement in the interconnected system very appreciable amounts of power may be transmitted over long distances without excessive loss. This plan of operation would permit the metropolitan companies to dispose of off-peak energy and would give an improved load factor. Owing to the high economy of these large steam stations, a large saving in total cost would be made.

NON-PROFIT INTERCHANGE BASIS

In order to obtain all of the advantages of interconnection with other companies, as previously outlined, it is necessary that the flow of power over these lines be determined almost entirely by the physical requirements and the available sources of power. Operating agreements between different companies should be such that these agreements will not prevent the operating departments from obtaining power freely from other companies when required for load or to obtain economies. One way of accomplishing this, as has been done in some instances, is by making agreements covering interconnections and exchange of power in which the charges for energy are such that the delivering company neither makes nor loses any money by the transaction. In all phases of power exchange the same principle should apply.

One outstanding point is that one of the major savings obtainable by interconnection and unrestricted exchange of power is the release in capital investment and the reduction in operating costs. If the attempt is made by any company to obtain further advantages by adding a profit to the sale of interchange power to other companies, the major advantages of the entire plan are largely nullified.

These remarks do not, of course, apply to a straight purchase or sale contract in which firm power and energy is sold by one company to another.

The committee recommends that the towers and substations be erected to accommodate lines operating at 132,000 volts, the initial installation to be insulated for and operated at a lower voltage which will take care of the requirements in the near future. It is recommended that this lower voltage be either 66,000 or 110,000.

The frequency of 60 cycles is recommended as a standard for future construction, and it is recommended that systems operating at other frequencies change to 60 cycles if or when it is practical to do so.

COMMITTEE ORGANIZATION AND PERSONNEL

The transmission lines committee was formed of system managers, superintendents and engineers from companies representing practically all classes of steam plants, hydro-electric plants, transmission systems and combinations of these, consulting engineers of several companies and representatives of the two largest electrical manufacturing companies.

The committee was divided into four sub-committees, which worked as follows:

1. The committee on load, distance and voltage made a study of the loads on the various major systems in the districts under consideration, the distance between the load centers of various systems and the voltages which appear best suited for the interconnecting lines.

2. The frequency committee made a study of the frequencies at which systems are operating at present in New York State, the load carried at the different frequencies and the policies of the various interests with reference to retaining the present frequency or adopting a frequency of 60 cycles; also of the relative growth of 60-cycle and 25-cycle systems throughout the United States as shown by reports from the two largest manufacturers of electrical equipment.

3. The line and substation costs committee made studies of the construction costs of transmission lines and substations for 66,000, 110,000 and 132,000 volts. Its report includes detailed estimates of these costs, together with such supporting data that these estimates may be used as a guide at any time by the substitution of revised cost figures. The report includes also one-line diagrams of the substations on which the committee's estimates were made.

4. The liaison committee gathered information from companies and organizations in Vermont, Massachusetts, Connecticut, New Jersey and Pennsylvania, and the results of its work outside New York State are shown on the maps prepared by the load, distance and voltage committee.

DISCUSSION OF INTERCONNECTION

This report is based on a survey of the electrical systems in New York State and to a limited extent in adjacent states, and is intended to show the possibilities and advantages obtainable through interconnection of the various systems for the interchange of power. The plan contemplates the exchange of power in amounts up to 25,000 kw. when operating at 66,000 volts, as is recommended for the immediate future. This interchange of power would be between adjacent systems or load centers or from generating stations of

one system to loads of another. In cases of long-distance transmission of power the operation would be very largely by means of load displacement. The report is not intended to cover transmission of very large blocks of power from generating sources to distant load centers, as was outlined in the superpower report. Interconnection, in order to be of maximum benefit, should be interstate as well as throughout individual states or sections.

Some provision will be necessary in operating organizations of interconnected companies in the direction of forming a clearing house for gathering and distributing the exchange power. It will be very advisable for some central operating organization to be set up to which reports of excess power, on the one hand, and demands for power, on the other, will be sent in regularly, so that a co-ordinating operator can arrange for the collection, transmission and distribution of the exchange power as required. Particular attention should be directed to the necessity of high-grade and adequate construction in all parts of the systems which become interconnected. The circuit breakers used in connection with the lines and substations should have sufficient capacity to take care of the full requirements. Connections between the main substations on the interconnecting systems and the local systems should be well protected by means of reactors, to prevent severe disturbances in case of short circuits in the local systems.

Many times plans have been made for new stations, extension of existing stations or existing systems which have been proved in a very few years to have been entirely inadequate for the purpose. The caution is here thrown out that it is well to make plans for all new stations and extensions on a very broad scale, making provision in the plans, in the grounds purchased, and in some cases, in the buildings erected, for a very large expansion.

EFFECT OF INTERCONNECTION ON CAPITAL INVESTMENT AND PLANT CAPACITY

Generating capacity in New York State central stations:	Kw.
Steam	1,500,000
Hydro-electric	1,000,000
Total	2,500,000
Portion of above affected by interconnection	1,000,000

1923

	Without Interconnection, Kw.	With Interconnection, Kw.
Plant capacity affected	1,000,000	1,000,000
Steam	400,000	400,000
Hydro-electric	600,000	600,000
Cost of above:		
Steam, at $125 per kilowatt	$50,000,000	$50,000,000
Hydro-electric, at $150 per kilowatt (present estimated cost)	90,000,000	90,000,000
	Kw.	Kw.
Reserve capacity over peak requirements (12 per cent)	120,000	180,000
Steam	*90,000	†135,000
Hydro-electric	*30,000	†45,000
Capital released for future load (difference between cost without interconnection and with interconnection)	.....	7,875,000

1933 (9 Per Cent Annual Increase)

	Kw.	Kw.
Plant capacity affected	2,370,000	2,133,000
Steam	870,000	783,000
Hydro-electric	1,500,000	1,350,000
Cost of above:		
Steam, at $125 per kilowatt	$108,750,000	$97,875,000
Hydro-electric at $175 per kilowatt (future estimated cost)	262,500,000	236,250,000
Saved by interconnection:		
Steam	.....	$10,875,000
Hydro-electric	.....	26,250,000
Capital released by interconnection		$37,125,000
Cost of interconnecting lines to make above possible		10,000,000
Line capacity (two No. 4/0 circuits), in kw.		25,000

* Reserve of each company available to that company or connected companies only.

† Available, up to capacity of interconnecting system, to any company.

The supply of power from one transmission system to another necessarily reverses the direction of the normal power flow in the receiving system for a certain distance, and there is a consequent reversal of the voltage gradient over this distance. The distance over which the power flow is reversed depends upon the amount of power interchanged and the load distribution along the line. For a supply of power of reasonable continuity and for an appreciable period of time this reversal of voltage gradient can be met to some extent by changing taps of the transformers at distribution points, especially if such transformers are equipped with ratio adjusters which can be operated without removing manhole covers. This method, however, will be in most cases impracticable for intermittent supplies on account of the load interruptions required for operating the ratio adjusters. At an appreciably increased cost external reactances can be provided which will permit changing transformation ratios without load interruption.

More adequate correction of the voltage regulation can be effected by the application at proper points of synchronous condensers. These can be connected to the secondaries of boosting auto-transformers or three winding transformers with necessary taps in the high-tension windings. This synchronous-condenser equipment can probably be usefully employed at all times for voltage and power-factor regulation at the end of the transmission system, even when no power exchange takes place between the interconnected systems, and its installation will in some cases be justified without establishing the interconnection.

For the interconnection between the western and central New York systems the voltage regulation question is less serious on account of the necessary regeneration from 25 cycles to 60 cycles between these systems, which will permit of independent voltage control at the point of interconnection.

POWER CONTROL

The control within predetermined limits of the power supply between interconnected transmission systems, each having miscellaneous power sources, is a problem which has to be worked out by the respective operating organizations. Division of load between both systems, although somewhat influenced by voltage regulation and load distribution, is primarily determined by governor adjustment and characteristics of prime movers at each power source. At the present time there is no device available which will control the load division at points of interconnection. However, the problem of load division has been worked out satisfactorily for systems under control of one operating organization and also for systems under different operating control. It does not seem possible to work out in advance a method which will insure predetermined load division between interconnected systems, but through the co-operation of the respective operating departments this problem is capable of satisfactory solution.

The direct interconnection of two transmission systems without the introduction of a two-winding transformer may require for satisfactory operation that the transformer neutrals be connected to or insulated from ground in the same manner for both systems, in order that the relay and lightning-arrester operation in one system shall not be interfered with when interconnected with another transmission system. Moreover, the interconnecting of two systems necessarily exposes one

system to disturbances originating in the other system. In case of ungrounded or high-resistance neutral operation the accidental grounding of one conductor in one transmission system necessarily raises the voltage to ground of the two other conductors in the entire interconnected system to the full delta voltage. Some of the lesser insulated lines of one system may therefore cause considerable communicating trouble in the systems interconnected therewith, unless proper engineering and construction is followed.

If adjacent systems are supplied by power sources too far apart, and there is too much resistance drop in the lines between such sources, the generators of the respective systems may operate unsatisfactorily on account of hunting. While this is unlikely to occur on the systems in question, yet it is a possibility.

EXISTING TRANSMISSION LINES

Several transmission-line sections have been built with structures which will permit operation at 110 kv., or, if necessary, 132 kv. No circuits are operated at the present time at a higher voltage than 66 kv., but plans are being executed for increasing the operating voltage to 110 kw. on certain lines before 1924.

The lines through New York State from Westchester County in the south to Massena in the north and Niagara Falls in the west will be continuous by 1924 with the exception of three gaps:

1. From the northern terminal of the 45-kv. line of the Westchester Lighting Company at Peekskill to the United Hudson Company's at East Walden, approximately 30 miles.

2. From the Northern New York Utilities 110-kv. line at Brown's Falls to the southern terminal of the 80-kv. line of the St. Lawrence Transmission Company at Pyrites, approximately 23 miles.

3. From the western terminal of the 66-kv. line of the Adirondack Power & Lighting Corporation at Oneida to the eastern terminal of the 110-kv. lines of the Niagara, Lockport & Ontario Power Company at Woodward, a distance of approximately 30 miles. In addition to the connecting transmission lines, frequency-changing equipment is necessary for interconnection at this point.

As explained previously, however, some of the lines are of relatively small capacity.

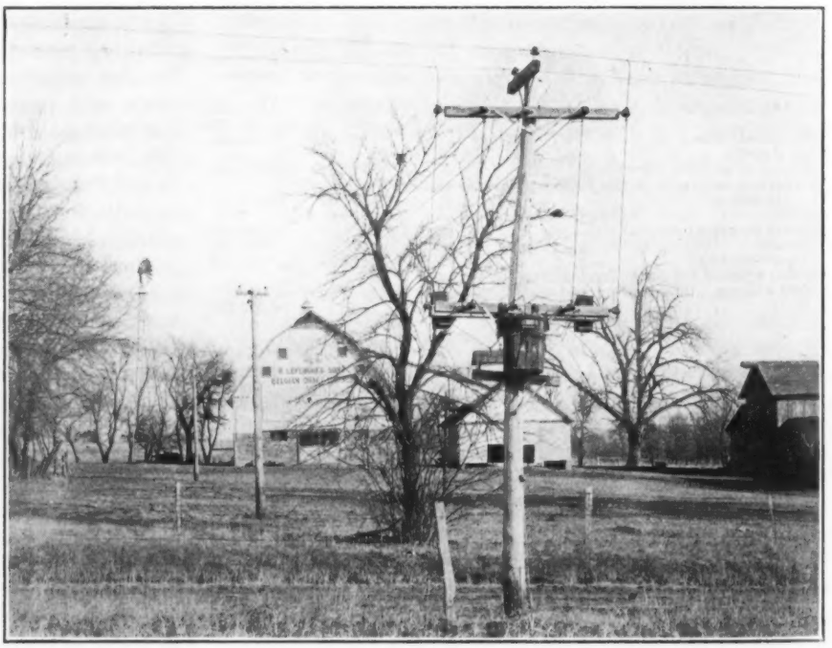
[The present situation with reference to interconnection in New York and neighboring states is shown in a comprehensive map, prepared by the committee and published as a supplement to this issue of ELECTRICAL WORLD.]

The interconnected system, as covered in this study and as indicated in the table, will have a line capacity of 25,000 kw. at 66,000 volts. It should be kept in mind, however, that all companies in the interconnected system except those on the ends of transmission lines may obtain power from more than one direction, some of them possibly from three or four directions. The system as proposed would, therefore, make it possible for the intermediate companies to obtain two or more times the amount of power indicated if they have need of it.

Rural Electrification Experiment in Minnesota

Joint Investigation to Determine Maximum Economical Use of Energy on Farms—Other States Likely to Start Similar Studies

ELECTRIC utilities in Minnesota which have been active during the past in serving rural communities where it was economical to do so have taken the lead in actually starting a co-operative investigation to determine the economic possibilities in farm electrification. In other words, a study will be made jointly with farmers and others interested in agriculture in which it will be determined how far the electrical comforts and conveniences of city life can be extended to the farm and still be made to pay for themselves in value of home and farm work performed and saving in labor. This activity is in line with a movement initiated by the National Committee on Relation of Electricity to Agriculture (Dr. E. A. White, director, Chicago), which is composed of representatives of the United States Department of Agriculture, American Farm Bureau Federation, American Society of Agricultural Engineers, National Electric Light Association and manufacturers of isolated farm electrical equipment. Similar co-operative studies are expected to start very soon in other states, considerable interest having been manifested already in Iowa, Kansas, Wisconsin, Ohio, Alabama, California, Oregon, and New England.



EVERY ELECTRICAL CONVENIENCE FOR HOUSEHOLD AND FARM USE BEING TRIED OUT ON EXPERIMENTAL FARMS

To accomplish the results for which the national committee is working a conference of state farmers and others interested in agriculture was called in Minnesota by J. F. Read, president of the Minnesota Farm Bureau Federation, in co-operation with the Northern States Power Company, which is operated under the direction of the Byllesby Engineering & Management Corporation. It was acknowledged that the farmer wants elec-

tric service and should have it, but it was pointed out that it is an economic problem whether, under present conditions, electric service companies can furnish power in every rural community at rates which will be attractive to farmers and at the same time sufficiently remunerative to the supply company. It was also pointed out that the national committee has decided, after a general analysis of the situation, that the solution of the problem, if there be a solution, lies in a careful consideration of the information which can be obtained only after a study shall have been made of the following subjects:

1. Effect of power applications on agricultural prosperity.
2. Extent to which labor is used throughout the year on farms, with a view toward ascertaining how it can be maintained at a more uniform figure by greater application of power.
3. Total cost of farm operations and relation of farm power and labor expense thereto.
4. Extent of uses of power on different types of farms in different localities.
5. Use of power in foreign agriculture and practicability of adopting some foreign methods in this country.
6. Peculiarities and magnitudes of agricultural power requirements as well as hand operations that might be electrified.
7. How farm processes requiring mechanical or hand power can be modified to increase economy of operation.
8. New applications of power on farm.
9. Maximum economic use of power on farms with present practices.
10. Possibility of conducting some industrial operations in rural districts to utilize labor during off-peak farm activity period.
11. Effect of electricity or some of its converted forms on plant growth, bacteria, preserving milk, curing hay, drying fruit, etc.

INVESTIGATIONS THAT ARE IN PROGRESS

Some of these investigations will have to be conducted nationally, it was explained. For example, considerable information regarding items 1 to 6 inclusive has already been collected by the Department of Agriculture but must be culled out of records and reclassified. This is a big job on which the Department of Agriculture is already at work. Farm management associations and agricultural schools will undoubtedly be interested in studying item 2. Item 4 is a subject which Secretary Hoover of the Department of Commerce promised to investigate at a recent conference between the national committee and some Washington officials. Items 6 to 10 inclusive are subjects which it is believed can best be investigated in state co-operative committees. Item 11 is chiefly a subject for agricultural colleges or private and commercial laboratories. The chief thing is to have these activities co-ordinated and directed. This will be done in a national way by the national committee, while state committees which may gradually be formed will function as the co-ordinating force on local matters under the supervision of the national committee.

In the Minnesota conference at which these plans were discussed it was pointed out that items 6 to 10 inclusive are subjects which are within the province of investigation by state co-operative committees. To enable these investigations to be conducted, the electric company proposed (1) to build a short experimental line from one of its primary transformers through a rural community composed of a dozen or so farms; (2) to furnish power at a reasonable charge to be determined later; (3) to assist in securing farm equipment free of charge from manufacturers; (4) if the farmers would co-operate, to keep records of costs, economies and benefits derived from different electrified devices and processes. Several farmers manifested their interest by accepting the terms and Red Wing has been selected as the point just outside of which the trial line will start. It will be at least 5 miles in length and serve at least fifteen farms from a primary transformer. (See ELECTRICAL WORLD, Nov. 10, page 981). Each customer will be permitted a demand of 3 kw. on which he will pay a fixed amount per month to cover overhead charges on generation and transmission. The 5-mile rural line in this case will cost about $4,875, or about $325 per farm, excluding connecting lines to the farmhouses and buildings. In any case the farmers will pay for the low-voltage services from the distribution line to the farm house or buildings, and the supply company will furnish and install the meter.

COST OF RURAL LINES TO FARMER

If the farmers pay for the erection of the line and turn it over to the supply company for maintenance, the total fixed charges for each farmer will be $4.76 per month. If the supply company builds it, the charge will be $6.90 per month. To these fixed charged are added 75 cents a month per customer for reading the meter, bookkeeping and "shooting" line trouble and 25 cents a month per customer for transformer losses. Energy will be charged for at the rate of 5 cents per kilowatt-hour for the first 30 kw.-hr. and 3 cents per kilowatt-hour for excess. On this basis and with the company building the line, the total cost to a farmer using 100 kw.-hr. per month will be $10.50 per month, or 10.5 cents per kilowatt-hour if all fifteen farmers participate. If he uses only 30 kw.-hr., the total monthly cost will be $8.40, or 28 cents per kilowatt-hour.

The farmers were apprised of the fact that if they used energy only for lighting their expense would be high, but if they found other uses that would raise the consumption above the average of about 27 kw.-hr., the cost would be reduced in proportion to the extent of use. The aim is to show how farmers can use 100 kw.-hr. a month to advantage without exceeding a 3-kw. demand. It was pointed out that any benefits resulting from electrification which in the aggregate would be equivalent to $125 per year in reduced operating expense, convenience or the like would pay for 100 kw.-hr. per month. Any greater advantages would make the use of electricity an economical investment.

On these experimental farms it is purposed to install every electrical convenience for household and farm use. The women's work will be lightened by washing machines, ironers, vacuum cleaners, dishwashers, toasters, etc. To aid the men in their work equipment will be provided for milking, separating, pumping, grinding, threshing, etc. The extent of electrification will be limited only by the character of the farming conducted and by the variety of equipment that can be obtained or newly invented. Energy required for operating equipment which does not show favorable results will be deducted from the farmer's bills.

With the data which are to be collected from these

experiments and the results of first-hand studies to determine how farm operations can be modified to adapt them to more economical use of power, it is expected that farmers can be informed definitely of ways in which they can use electricity to more extensive advantage; manufacturers of equipment will become better acquainted with the farm-power problem; agricultural engineers and farm management associations and similar bodies will be better equipped to advise desirable changes in farm operation, and electric service companies will be able to develop rural loads which can be served at attractive rates and still earn a reasonable profit.

Standardization of Electrical Units in Terms of Length, Mass and Time

A MICROMETER of extraordinary accuracy, capable of determining measurements of one one-hundred-thousandth of an inch, has been perfected by the Bureau of Standards for measuring the diameter of some 12-in. porcelain cylinders to be used in electrical measurements. The new instrument makes measurements independent of the observer. In order to obtain this degree of accuracy it is necessary to operate the micrometer from a distance and to take readings from it through a telescope, lest the heat of the observer's body warp the thick steel ring sufficiently to cause an error. Both the instrument and the cylinder must be kept in a constant-temperature box during the measurement.

The micrometer consists of a cast-iron ring large enough to pass easily over the 12-in. cylinders. On opposite sides are the micrometer screw and the contact pin, while at right angles are adjustable lugs for centering the device on the cylinders. The micrometer screw is driven by a tiny electric motor, and when it has pushed the cylinder against the contact pin the latter breaks the motor circuit and stops the screw. The whole device when in use is suspended by three light rods and can move freely the short distance required. The cylinders which are to be measured will be wound with wire on a precision lathe and will form inductance coils of very accurate construction whose inductance can be calculated from the dimensions.

This research is a part of a program for standardization of all of the electrical units in terms of the fundamental standards of length, mass and time.

Six Hundred and Sixty City-Owned Plants Abandoned

MORE than 660 municipally owned electric plants and other public utility properties have either been abandoned or have reverted to private ownership, according to a survey just completed by the National Electric Light Association, which was based largely on United States Census Bureau compilations. The report shows that the average rate of municipally owned plants is more than twice as high as the average rate of all companies reported. Other facts disclosed by the report are:

In 1912 power was purchased by 8.7 per cent of the municipal plants. In 1917 power was purchased by 23.3 per cent.

Of the population of the United States served with electricity the companies serve 93.8 per cent and the municipal plants 6.2 per cent.

The average city tax rate in 1921 as shown by the United States Census in cities of over 30,000 having municipal plants doing commercial business was $19.31. The average city tax rate for the non-municipal plant cities nearest in population to the above was $15.50. Exempting municipal plants from taxation necessarily means that the tax rate on other property must be increased.

Letters from Our Readers

A Place Set Apart for Suggestions, Comments and Criticisms, to Which All Men of the Electrical Industry Are Cordially Invited to Contribute

No Interference from Supervisory Control

To the Editors of the ELECTRICAL WORLD:

Some engineers have raised the question of whether there is not a probability of inductive interference being caused by the use of supervisory control systems, especially if the distributor system with polarized relays is used. These engineers and other skeptics must remember that interference can occur only between open wires. If either the power or control circuits are inclosed in cable, this condition is eliminated. Furthermore, even if open wires are used, the relays which are used in the supervisory system will not respond to the commercial frequencies which can be transferred from a power line to the supervisory control circuit. Consequently the argument that the polarized relays make the distributor system susceptible to inductive interference does not hold. CHESTER LICHTENBERG.

General Electric Company,
Schenectady, N. Y.

High-Class Overhead-Line Construction

To the Editors of the ELECTRICAL WORLD:

It is a very great pleasure to inspect overhead-line construction of the high class shown and described by D. J. White in the ELECTRICAL WORLD for Sept. 29, page 662. It is easy to understand, with secondaries and primaries laid out as Mr. White has done, why troubles were reduced by two-thirds. The proper use of secondary racks is in sharp contrast with the slovenly construction that is all too prevalent, and Mr. White is to be congratulated on the showing he has made.

The proper location of the neutral on the top spool of the rack is so infrequent as to excite comment when it is tied in correctly. One of the chief advantages of the secondary rack is the means of interposing the grounded neutral between falling primaries and the "outside" legs of the secondary main, yet the writer knows of several cities where a general rebuilding is in progress using secondary racks, where the neutral is tied into the middle insulator, leaving the upper wire exposed to falling primaries and foreign wires. It is extremely doubtful if such construction justifies the expenditure necessary to change from the cross-arm type of construction, especially if extremely light-weight racks with their attendant short life be used.

The writer has always advocated, as a means of avoiding future troubles from secondary racks, that the wires be tied on the outside of the insulators, i.e., on the side away from the pole. It is a more or less natural procedure for a lineman to pull in the wires between insulator and the steel of the rack, as a means of support is thus afforded during stringing, and it is also argued that if the wires should ride down off the insulator at a

later date, they will not fall to the ground. It should be appreciated, however, that, if they should ride down, they will in this position ground on the steel of the rack, and inasmuch as the displacement from normal position will be only about two inches, it will be difficult for a trouble shooter to locate the fault. If the wires are tied on the outside of the insulators, a loose wire would fall free of the rack and be supported by adjacent poles at a level several feet below the rack in a position very easy to detect. If racks are used for crossings over busy streets, tracks or where clearance is small, the inside tie would probably be desirable, but in residential sections and outlying districts, where secondaries sometimes stretch out to a pretty good length, the outside tie is felt to be far superior.

L. C. PETERMAN,
Engineer Electrical Division.
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Why All Test Data on Oil Circuit Breakers Cannot Be Divulged

To the Editors of the ELECTRICAL WORLD:

Regarding the questions which have been asked concerning my letter of Sept. 15 in reference to plain-break versus explosion-chamber types of oil circuit breakers, it should be realized that a great deal of the information which might be requested concerning these breakers is considered as confidential technical data by the General Electric Company and not to be divulged to any one at this time. The reason for this stand is twofold.

Improvements are being made in the oil-circuit-breaker art as a result of the thousands of tests which have been made and which are being continued daily, and it is not desirable to divulge all the test data until the improvements have been completed. Moreover, the engineer or operator who might request the information might easily draw wrong conclusions from the data submitted, because he has had no opportunity of learning facts and will draw what to him are logical deductions and make serious mistakes in so doing.

From his experience with mechanics, electricity and magnetism and the accurate constants pertaining thereto, he would draw logical conclusions, but with the plain-break oil circuit breaker there are no such general accurate constants in the present type of apparatus. To draw safe conclusions an accurate knowledge of the maximum or minimum value of widely varying values must be had, and these can be had only as the result of exhaustive tests made upon full-size apparatus equipped with the necessary measuring instruments.

For instance, a series of one hundred short circuits by an oil circuit breaker on a given generator and circuit upon which no changes are made during the tests may give an arc length of 2 in. or less as a minimum and 9 in. or 10 in. as maximum. The gas generated may be, as an illustration, perhaps 1 cu.ft. or 3 cu.ft or more. The engineer without experience would reason that interrupting a given current at a given voltage under given conditions would give a definite arc length and a definite quantity of gas generated, but in so doing he would make a serious mistake.

Data obtained from tests made with small apparatus are useless when applied to the design of large ones. The results of foreign tests are being used today by engineers to check up the probable modern oil-circuit-breaker performance. No greater mistake could be made than to use the results of these tests for such work. The above remarks, which apply particularly to plain-break breakers, have been made that engineers may have a better conception of the functioning of the oil circuit breaker and of its extreme fluctuations. In the case of the explosion chamber the variations are much less than in the case of the plain break, and the breaker performs much more consistently.

My letter of Sept. 15 was not written with the idea of giving specific data on any particular oil circuit breaker, but to confirm the South African conclusions and to compare more specifically the two types of breakers, and to that end all conditions affecting a series of tests of the two breakers were made as nearly identical as it was possible to make them. Neither type of breaker was favored in any way, and the results obtained indicate the efficiency of the two types tested as nearly as we are able to make comparisons.

Whether the tests were made single-phase or three-phase, delta or Y, grounded or ungrounded, at unity or zero power factor or intermediate value, whether the breaker was connected to an isolated bus with no other load or in multiple with loads of static transformers, induction or synchronous motors and loads of various magnitudes, whether the test was made at the end of a long line or at the generating station, what the full speed of the breaker (at no load) may have been, are all of no moment and would act only to confuse the results in the mind of the reader. The vital fact is that during the comparing tests all conditions were the same for the breakers being compared so far as we were able to make them the same. If one breaker has, for instance, a different speed characteristic than the other under load, it will show up in the behavior of the breaker and be charged against or credited to it in the final conclusions.

A pertinent question might be asked in reference to the curve Fig. 6, showing the variation of arc lengths with the current. Strictly speaking, this plot does not show the arc length unless this length is represented by a straight line between contacts. The ordinates do represent the *separation* of contacts at interruption, and it was assumed that the arc did hold in a straight line between stationary and movable contacts.

With very heavy currents the arc is undoubtedly deflected from the straight line by the inherent magnetic blow-out effect and the mean arc length would undoubtedly be greater than the direct line between contacts at interruption. It should be remembered, however, that with high-tension circuits the current is not sufficiently large to give any pronounced blow-out effect, particularly as this blow-out effect is not entirely (or largely) due to the normal field between studs of the breaker, but is due to a local loop of fairly small diameter which is made possible by the small separation of contacts required for interruption at comparatively low voltages. With high-voltage circuits this condition does not exist, and the inherent magnetic blow-out effect is comparatively small and of little value in determining the interrupting capacity of such breakers.

The switchboard department of the General Electric Company would be glad to answer directly to the inquirer such specific questions as may be asked on its oil circuit breakers of any type, if the question can be answered without the divulging of confidential data. There are many questions that can be freely answered and explanations that can be made which will greatly limit the liability of drawing wrong conclusions.

JOHN D. HILLIARD,
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Central Station and Industrial Practice

Installation, Operation, Maintenance, Test and Repair of Generation and Distribution Equipment, and Methods of Economically Utilizing Electric Service in Large Industrial Plants

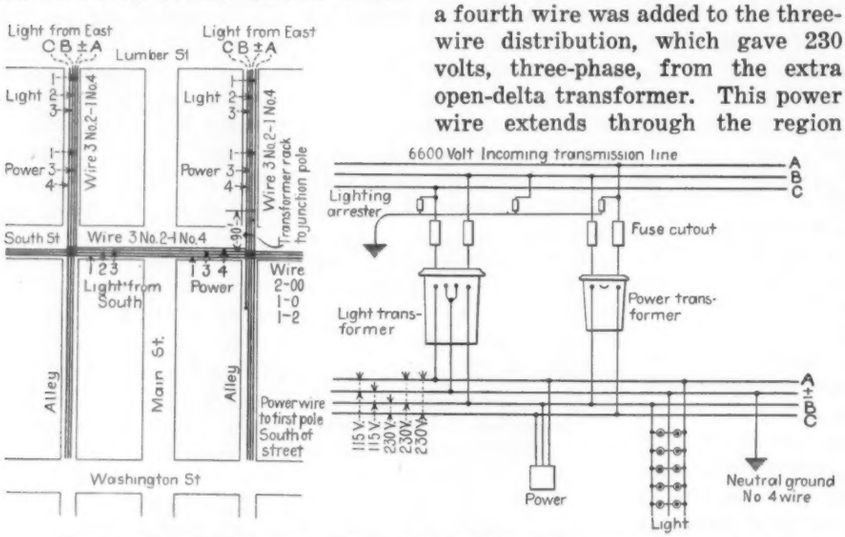
Supplying Power Lines from Lighting Circuits

By D. G. Wallace
Operating Engineer Illinois Power & Light Corporation, Bloomington, Ill.

IN LAYING out distribution circuits in localities where power loads are not large enough to warrant the additional heavy distribution investment, some scheme must be worked out which will not seriously jeopardize the line regulation of the lighting consumers. This situation is not so troublesome in virgin territory as in places where the distribution circuits have grown up rather hurriedly owing to a rapidly growing demand for power during the past few years.

Such a problem confronted the Illinois Power & Light Corporation when it was required in 1921 to give service to the town of Flanagan, about 40 miles north of Bloomington, Ill. But since there had theretofore been no electric power in the town, the utility company had a chance to develop a complete new distribution system without being hampered by questions of old investment and precedent. The manner in which the company handled the circuits to include power consumers without entailing very much additional expense is shown in the accompanying illustration.

The transmission voltage entering Flanagan was 6,600. This was stepped down for the lighting distribution circuits to 115 volts and for power to 230 volts. The general lighting distribution was handled through three transformers, while for power a fourth transformer was connected open-delta as shown in the accompanying illustration. All main secondary circuits were run three-wire with the center wire two sizes smaller than the others. For power a fourth wire was added to the three-wire distribution, which gave 230 volts, three-phase, from the extra open-delta transformer. This power wire extends through the region where large motors are employed. Such an arrangement avoided the added expense of a separate power circuit of three wires, and as the power load is nearly all in the daytime, this system makes a flexible distribution, keeping the costs at a minimum.



SUPPLYING POWER IN CONJUNCTION WITH LIGHTING CIRCUITS IN SMALL COMMUNITIES

For balancing loads a distribution map was drawn up as shown. It indicates the transformer location and the wire sizes and differentiates between the power and lighting circuits. For street lighting a constant-current, 220-volt transformer operating at 6.6 amp. is connected directly to the power transformer, thus eliminating the expense of a 6,600-volt street lighting transformer.

Check Tests on "Glassteel" Lighting Unit

TESTS have been made by the National Lamp Works and the Commonwealth Edison Company to determine the characteristics of the "Glassteel" lighting unit made by the Benjamin Electric Company, which were reported by Wyllis E. Quivey, illuminating engineer of the Benjamin company, at the Chicago Section meeting of the Illuminating Engineering Society, Oct. 31. This unit is similar in some respects to the RLM reflector, but has a diffusing-glass inclosure for the lamp and permits some light to radiate toward the ceiling.

According to tests, the light in the 0-60-deg. zone ranges from 42 to 46 per cent of the bare lamp flux; that in the 0-90-deg. zone ranges from 54 to 60 per cent; that in the 90-180-deg. zone is about 7 or 8 per cent, while the flux in the 0-180-deg. zone is 62 to 67 per cent. The published efficiency of the RLM dome, it was reported, is 66 per cent, or slightly more than the average for the new unit.

Using a 300-watt clear lamp in the "glassteel" unit, the brightness per square inch of exposed surface ranges from 3 cp. to 8 cp., as compared with 15 cp. for the RLM dome. When sighted at an angle of 45 deg. the brightness contrast between the new unit and the ceiling is about 250 to 1. This condition existed with a unit mounted 36 in. below a whitewashed tile ceiling in fair condition. Compared with this the brightness contrast of an RLM dome is 1,000 to 1 and upward, it was contended.

Demonstrations showed that the shadows from the "glassteel" unit are more vague and more luminous than for an RLM reflector because of the greater uniformity of brightness across the open mouth of the new unit. However, the new unit requires more attention for proper maintenance, since the depreciation in efficiency under the same conditions was in the ratio of 22.9 to 16.3 for the "glassteel" and RLM respectively.

Testing and Repairing Poles on Transmission Line

BY J. H. SIEGFRIED
Superintendent of Power Pacific Power & Light Company, Kennewick, Wash.

TO PREVENT failures and prolong the life of a 45-mile, 66,000-volt transmission line from Walla Walla to Pasco, Wash., the Pacific Power & Light Company is carrying on a thorough inspection and repair of defective poles. The line was built in 1911, and during the early part of this year heavy wind storms broke a number of poles in a section of the line which had not been inspected, showing the necessity of a systematic inspection and repair of the whole line.

The work consists of straightening, resetting, stubbing and reguying the poles where necessary. Five men with a Dodge truck compose the crew. Every pole is first tested by digging 18 in. below the ground line on one side and boring a ¾-in. hole diagonally from that point about two-thirds of the way through the pole. The borings are watched and examined carefully and indicate the condition of the heart of the pole. If the pole is found solid, the hole is filled with creosote and a cedar plug is driven in to prevent any decay starting at the test hole. If the pole is unsound, a hitch is taken around it and a double set of triple sheave blocks attached to an 8-ft. A frame (shown in Fig. 1) is used to raise the pole from the ground. Temporary side guys keep the pole upright as the work must be done with the line "hot." The pole is sawed off just above the ground line and the butt swung to one side. The remaining stub is pulled out with a pole jack as shown in Fig. 2. After creosoting the butt of the pole and cleaning out the hole, the pole is lowered into the hole and retamped. Before the hitch is taken on the pole it is creosoted to a point which will be above the ground line when the pole is reset.

FORM 1090

PACIFIC POWER & LIGHT COMPANY

POLE RECORD

Walla Walla-Attalia SECTION POLE NO. 742 HEIGHT 60 FT.

CONSTRUCTION	ARM	INSULATORS				GUYS	CIRCUITS	TELEPHONE
ST. LINE ✓	SINGLE ✓	TOP		BOTTOM		NO.	DOUBLE	BRACKET
CORNER	DOUBLE	PIN NO.	SUSP. NO.	PIN NO.	SUSP. NO.		SINGLE ✓	PIN ✓
STRAIN	BUCK					TYPE		TRANSPOSITION
SEMI-STRAIN		1		2				
TRANSPOSITION	OTHER WIRES ON THIS POLE	6600 Volt Distribution Line from TOUCHET SUBSTION						

INSPECTION

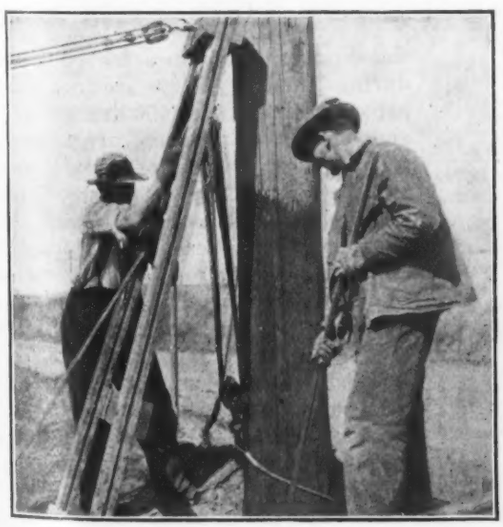
DATE	BY WHOM	CONDITION AS FOUND	WORK DONE TO CORRECT DEFECTS	DATE
4/14/23	Smith	Rotten Butt	Cut off and Reset	4/16/23

FIG. 3—TYPE OF CARD USED FOR PERMANENT POLE RECORD
The back of this card is ruled for noting date of change and another the position of all insulator changes. One column gives the insulator and the reason for the change.

The creosoting is done in a novel and effective manner. A piece of 6-in. pipe, fitted with caps at both ends, is used as a storage tank. In the cap at the top was placed a valve stem from an automobile tire. Eight feet of hose fitted with a nozzle, such as that used in spraying fruit trees, was attached to a valve in the cap at the lower end. The tank is partly filled with creosote and air pumped in with a hand tire pump. The creosote is effectively sprayed into all cracks and checks, the operation requiring less than one minute per pole.

At points where trees prevent the resetting of poles they are stubbed. Grass and weeds are removed from a 6-ft. circle around the poles and the line is left in first-class condition. The total cost of the work done on 709 poles was $1,150.85, an average of $1.62 per pole. Seven poles were reset in one day at a cost of $32.08, or $4.58 per pole. In another day ninety-one poles were tested and weeds removed at a cost of $27.65, or $0.304 per pole. The average cost of testing and cleaning 709 poles was $0.397 per pole. Only fourteen poles had to be stubbed. This work cost $149.77, or $10.55 per pole.

A card record is kept of the inspection and work done on each pole.



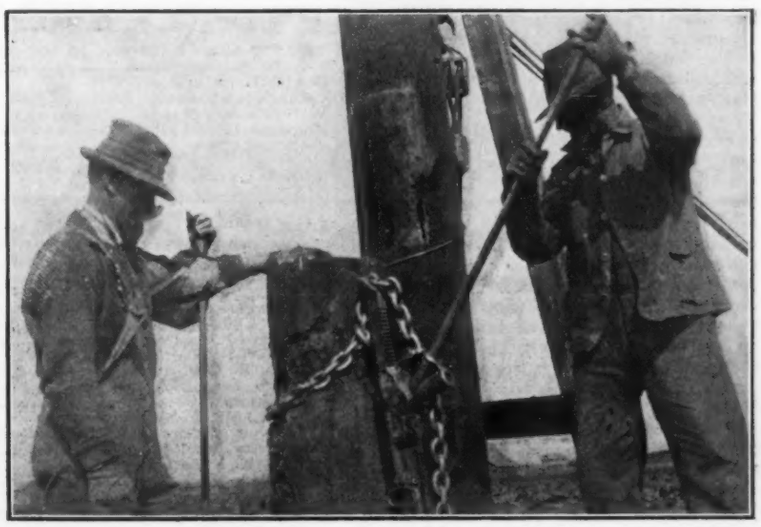


FIG. 1 (LEFT)—METHOD USED IN RAISING POLES TO BE RESET. FIG. 2 (RIGHT)—PULLING OUT A BUTT WITH A POLE JACK

A sample of the card used is shown in Fig. 3. The upper part of the card is used for a record of the type of line construction used on the pole. The result of the inspection is shown on the lower part of the card, while on the back a record of insulator changes is kept.

Systematizing Electrolysis Tests on Cable Sheaths

ELECTROLYSIS tests on cable sheaths of the Worcester (Mass.) Electric Light Company have lately been organized on a routine basis. All electrolysis matters are under the supervision of the company's distribution engineer and instructions for testing have been prepared as follows:

All matters connected with electrolysis are under the supervision of the distribution engineer. Electrolysis tests shall be made by the meter department on his request.

About July 1 of each year the distribution engineer shall furnish the meter engineer with a list of locations of manholes where electrolysis tests are to be made, and the tests shall be made as soon as possible thereafter by men from the meter department. The test consists of voltage readings between the sheaths of the Worcester Electric Light Company cables and the rails of the Worcester Consolidated Street Railway Company, and also, where possible, between the cable sheaths and a hydrant or other part of the city water system. Twenty readings must be taken, spaced ten seconds apart. The readings are not to be taken if a street car is within 200 ft. on either track.

ELECTROLYSIS TESTS

AT _____

DATE	TRACK	HYDRANT	OTHER TESTS

TYPICAL FORM FOR RECORDING ELECTROLYSIS TESTS

For each location a report must be made out by the tester on the form shown in the accompanying illustration. The voltage recorded should be the average of the twenty readings taken, and it should be plainly indicated whether the voltage is positive or negative. If some of the readings are positive and some are negative, the voltage recorded should be obtained as follows: The positive and negative readings should be added separately, the smaller sum subtracted from the greater, and the sum remainder divided by twenty, the polarity being that of the greater sum. If the manhole has water in it or is otherwise in poor condition, this should be reported on forms suitable for this purpose. At the same time the electrolysis tests are made the maximum demand meters at the Madison Square substation of the Worcester Consolidated Street Railway Company and in various manholes should be read and reset and the readings recorded on the proper meter reading cards. These meters should also be read about Jan. 1. The reports of the testers and the results of the maximum-demand-meter readings shall be turned in by the meter engineer to the distribution engineer.

A map showing the results of the tests at the different locations shall be prepared under the direction of the distribution engineer, who will then see that the reports are properly filed for the service office. This map shall be kept on file in the service office for each location where electrolysis tests have been made. These cards shall be filed alphabetically by streets. The result of each test shall be transferred to the corresponding cards from the report of the tester under the direction of the chief clerk of the service department.

Estimated Cost of Making Substation Changes

A MASSACHUSETTS central-station company serving a manufacturing city of about 20,000 population has found that increasing business requires the installation of voltage regulators for a new bank of 1,250-kva. transformers, building a new 13,000-volt bus structure with outdoor switches, installing a set of 2,500-volt oil switches and recopperring a principal power circuit.

A new transformer bank of 3,750-kva. total rating requires a set of regulators to enable the company to furnish a more acceptable commercial service voltage. The estimated cost of this work is given in Table I. At present there are two 13,000-volt feeders running from the company's substation, the switching equipment for which consists of but one 13,000-volt outdoor oil switch and one indoor oil switch of the same voltage rating. The addition of the new 3,750-kva. transformer bank necessitates providing a 13,000-volt wooden-pole bus structure and the installation of three more outdoor oil switches with arresters, etc. These costs are given in Table II.

TABLE I—INSTALLATION OF VOLTAGE REGULATORS

Two 500-amp., 2,300-volt 10 per cent I. R. S. regulators	$5,940
Foundations and erection	810
Conduit and cable	380
Wiring screens, etc.	820
Engineering, administrative and general expense	795
Total	$8,745

TABLE II—ESTIMATED INSTALLATION COST OF 13,200-VOLT BUS STRUCTURE

Field superintendence and tools	$648
Three 15,000-volt, KO-36 coil switches	7,128
One 15,000-volt metering outfit	756
One 15,000-volt arrester	756
Disconnecting switches	648
Foundations	540
Pole structures	810
13,000-volt wiring and installation	2,160
Temporary work	540
Conduit and control cable	540
Switchboard	540
Lighting	214
Engineering, administrative and general expense	1,528
Total	$16,808

The present oil switches at the company station were installed about 1908 and are considered obsolete in design and inadequate in capacity. With only the present transformers in service the switches would be called upon to rupture 50,000 kva. during trouble. They are not capable of rupturing 40,000 kva. safely, and with the addition of a new 3,750-kva. transformer bank these switches might be called upon to rupture 91,000 kva. on short circuit. In this case a serious fire might result. The situation is to be remedied by the installation of seven switches, the estimated cost of which is given in Table III.

TABLE III—ESTIMATED INSTALLATION COST OF 2,300-VOLT OIL SWITCHES

Field superintendence, labor and expenses		$5,940
Seven type K-32-C 600-amp. oil switches		4,612
Seven switchboard sections, 90 in. x 24 in. x 2 in.		648
Pipe framework and fittings		648
Conduit and fittings		540
No. 4/0 three-conductor cable		648
Addition to double bus		865
Fourteen type PQ relays		325
Fourteen type W-12 current transformers		430
Fourteen type E-18 potential transformers		540
Miscellaneous material		1,624
Engineering, administrative and general expense		1,682
Total		$18,502
Salvage—estimated cost of oil switches removed from service:		
Seven switches, at $62.60	$438.20	
Estimated labor of installation	350.00	
		788
Estimated total net cost		$17,714

TABLE IV—COST OF CHANGING 2¼ MILES OF LINE TO LARGER-SIZE WIRE

No. 1 copper for 4,000 ft. of circuit; i. e., 12,000 ft., or 3,600 lb.		$817
Labor and fittings		324
Trucking		54
Total		$1,195
Salvage:		
Estimated original cost No. 6 wire removed from service—4,000 ft. of circuit, or 12,000 ft. No. 6 wire—1,345 lb., at 16 cents	$215	
Estimated cost of stringing above wire, at $40 per mile (2¼ miles)	90	
		305
Net estimated total cost		$890

The present transformers in service the switches would be called upon to rupture 50,000 kva. during trouble. They are not capable of rupturing 40,000 kva. safely, and with the addition of a new 3,750-kva. transformer bank these switches might be called upon to rupture 91,000 kva. on short circuit. In this case a serious fire might result. The situation is to be remedied by the installation of seven switches, the estimated cost of which is given in Table III.

Considerable overload is being carried on the company's No. 1 circuit. The resulting line loss is serious, running close to 20 per cent, and the voltage regulation is troublesome. The use of larger copper will obviate the greater part of present troubles and allow increase of load

on the circuit. The cost of increasing this line to No. 1 wire is in Table IV.

Transformer Used as Ground Detector

BY S. F. JONES
Repair Shop, City Lighting Department, Seattle, Wash.

THE necessity for an inexpensive ground detector to be used on outlying feeders which do not emanate from a substation where an attendant is on duty has led Seattle's

FIG. 1—GROUND DETECTOR USED FOR ISOLATED FEEDERS

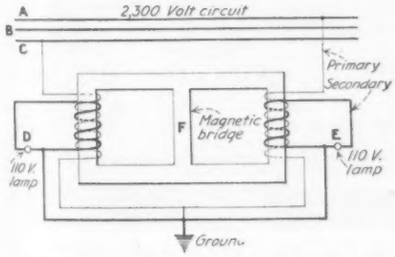


FIG. 2—MAGNETIC LEAKAGE PATH IS ESSENTIAL FEATURE OF GROUND DETECTOR TRANSFORMER

With no ground on the 2,300-volt circuit lights *D* and *E* burn at half brilliancy. With a ground on leg *C* light *E* burns at full brilliancy, and with a ground on leg *A* light *D* burns at full brilliancy. If leg *B* is grounded both lights burn at full brilliancy.

lighting department to develop the special ground-detector transformer shown in Fig. 1. The essential feature of the transformer is the magnetic leakage path *F* (Fig. 2). The two windings are connected in series so that the normal flux produced by these windings passes around the core in the same direction. When one primary winding is short-circuited by a ground on the line, the flux of both windings passes through the magnetic bridge *F*. The essential features of the transformer and the connection are shown in Fig. 2.

These ground detectors weigh about 50 lb. and cost about $40 each.

Field Testing Equipment and Its Maintenance

BY H. F. LEEPER
Meter Department, Ohio Power Company, Canton, Ohio

THE field testing equipment used by this company is divided into three parts, namely, three-phase meter-testing outfits, single-phase meter-testing outfits and direct-current meter-testing outfits. Of the first group there are two complete outfits, one of which is used in testing self-contained meters and the other in testing transformer meters. The self-contained meter-testing equipment consists of a fiber tool kit, 16 in. x 9 in., in which are carried tools and auxiliary apparatus which are essential to all three outfits. This kit also contains current leads of 100-amp. carrying capacity and two sets of potential leads made from No. 14 flexible lamp cord, one set of the latter being for the rotating standard and the other for the load box. The load box used with this outfit is the 75-amp. type F States phantom load.

The rotating standard for this equipment is equipped with 1, 5, 10, 15 and 100-amp. coils. The outfit suitable for transformer meter testing is identical with the self-contained meter-testing equipment except that the current leads are made from flexible No. 10 cord and a 15-amp. States phantom load is used. The rotating standard has only 1-amp. and 5-amp. coils.

The single-phase outfits differ from the three-phase in that the fiber kit is replaced by a rheostat and tool kit built into a single unit. The resistance coils of the rheostat range from 0.25 amp. to 15 amp. A single set of current and potential leads is used, the potential lead being No. 14 flexible lamp cord and the current lead No. 10. A 1-amp. and 5-amp. coil standard completes the outfit.

For direct-current meter testing two complete outfits are used. The first is for calibrating large direct-current meters and consists of a fiber tool kit as previously described. An Edison storage battery is used for obtaining the load. The second testing unit is practically the same as the single-phase outfit.

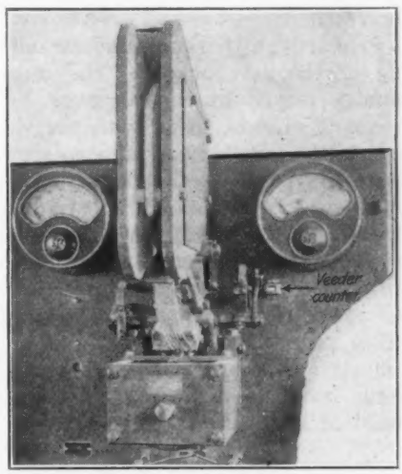
The maintenance of the testing equipment is taken care of by the shop foreman, who keeps a duplicate of each piece of apparatus and issues new when the old proves defective or is in need of repair. The old equipment is turned in, then repaired and kept in stock. New repair parts, such as jewels, etc., are issued only in exchange for the old.

AUXILIARY APPARATUS USED WITH METER TESTING OUTFITS

One 60-watt, 110-volt test lamp, with 3-ft. leads, having test clips on ends.
One two-cell flashlamp.
One fish and tackle box.
One magnet and balancing wrench.
One bronze magnet scraper.
One brush wrench (T.R.W. meters).
One lag-adjusting wrench.
One upper jewel wrench.
One pivot wrench.
One offset screwdriver.
Four small hexagon connections.
Two small switch connectors.
One T.R.W. brush needle.
One watch oiler.
Two small cut-out connectors.
One tooth brush.
Linen tape.
Crocus cloth.
Peg wood.
One rag.
One rubber syringe used to blow dust out of meter.
One small bottle of gasoline.
Sufficient supply of jewels, pivots and few small repair parts for day's work.
Pliers, ordinary screwdrivers and similar small tools supplied by tester.

Counter to Record Opening of Reclosing Switches

BY INSTALLING counters in connection with automatic reclosing equipment, relay contactors, etc., a complete check of operation may be obtained which will facilitate the location of any faults and will give an accurate record of the number of times the equipment opens or closes. This is particularly advantageous when equipment is installed at remote points as the record of operation gives a good basis to determine the period of examination of the apparatus. Veeder counters placed on equipment, as shown in the accompanying illustration, are being used by several companies, and now manufacturers are providing the counters on equipment where requested.



MOUNTING VEEDER COUNTER ON RECLOSING EQUIPMENT GIVES CHECK ON OPERATION

Central Station Business

Advertising, Selling and Service Methods
Commercial Organization and Management, Customer and Trade Relations, Public and Financial Policies, and Reports of Company Plans and Experiences

Electric Ranges Build Valuable Load

Central Station Concludes Second Successful Campaign, Which Will Add $28,500 in Yearly Revenue—14.9 per Cent of Residential Customers Now Use Ranges

BY J. T. RYAN
Washington Water Power Company, Spokane, Wash.

ADDING 316 electric ranges, each with an electric water heater, to a company's lines in five weeks is a considerable accomplishment in itself. That the Washington Water Power Company did this in face of the fact that only two months before it had terminated a six weeks' campaign during which 431 ranges and water heaters were sold makes the later sale even more remarkable. The value of this new business in gross annual revenue from energy consumed is put at $39,000 for the first campaign and $28,500 for the second. Thus the use of the total 747 electric ranges and water heaters will bring into the company some $67,500 per year. In view of the value of this load the methods used in staging the second campaign are interesting.

Primarily, a thorough understanding of the psychology of the community served by his company led Lewis A. Lewis, sales manager, to put on the second campaign so soon after the first. Enthusiasm in the sales department was first aroused at a banquet presided over by Ray W. Turnbull, representative of the Hotpoint-Hughes range, which was to be featured in the sale. The campaign opened on June 18, and on June 11 preliminary advertising was begun in the local papers. This consisted of four 12-in. blind advertisements consisting of a heart-shaped design inclosing the legend "$4.75 down" and the words "Watch for announcement." During the campaign illustrated advertisements were run, amounting to 1,461 in. in twenty-two insertions. Up to July 11 no reference was made to the price, which was $164.75, covering the complete installation of a bungalow type R-101 range, together with a water heater. This was payable $4.75 down and $7 per month. This price was $85 lower than that of the range sold in the previous campaign, during which it was observed that many people telephoned to ask the price of the range but could not be induced to consider buying. In the belief that many of these people would buy at the lower price, on July 11 the advertisements were changed by announcing the total price for a range and water heater installed. This radical departure from the previous methods produced a marked acceleration in the selling. In the smaller towns the price was advertised from the beginning.

As a special inducement a five-piece combination aluminum cooker set was given with each range. With every bill sent to residential customers during the campaign an attractive insert was attached. Illuminated signboards were displayed on principal car lines. One of these is shown in the accompanying illustration.

ILLUMINATED BILLBOARD USED IN SECOND SPOKANE RANGE CAMPAIGN

RESULTS OF RANGE AND WATER-HEATER* SALES CAMPAIGN

	Spokane	Towns Directly Served by Company	Total
Population	115,000	55,000	170,000
Residential customers	24,700	7,500	32,200
Ranges in use at beginning of campaign	2,598	1,887	4,485
Sales of campaign type ranges	153	101	254
Sales of other larger new ranges	31	31	62
Total new sales	184	132	316
Grand total in service	2,782	2,019	4,801
Percentage of residential customers using ranges	11.25	26.9	14.9
Gross sales value	.....	.....	$57,000.00
Gross annual revenue added by new ranges sold in campaign	.....	.....	$28,500.00

* The size of water heaters varied, but most of them were of 750 watts capacity.

SALESMEN'S COMMISSIONS

To stimulate the greatest possible effort among the salesmen, they received a commission of 10 per cent on the sale of each range and water heater, based on the cash price and not the partial-payment price. A quota was set for each salesman, based on his record during the previous campaign, and a bonus of $20 was offered to each man who made his quota. In addition each week a sum based on $2 per range for all ranges sold during the week was

divided, in the proportion of three, two and one, among the three city salesmen who sold the highest percentage of their respective quotas during that week. The sales in the city of Spokane were handled by five salesmen working full time and one working part time. Sales in the territory outside the city were made by the twenty-five regular district and local agents of the company. The results of the campaign, with data on the value of the business and total number of ranges in use, are given in the accompanying table.

It is worthy of note that the town of Wilbur, with 257 residential customers, now has 107 electric ranges in service; that is, 42 per cent of the residential users have electric ranges. Of particular interest is the fact that while sales efforts were concentrated on the bungalow range, approximately 20 per cent of the total sold were of larger and more expensive types.

Window Lighting Increased by Display Contest

THE Blackstone Valley Gas & Electric Company, Pawtucket, R. I., co-operating with the merchants' division of the local Chamber of Commerce, recently promoted a fall opening and show-window display contest which has resulted in a general movement toward better commercial illumination in the city. As lighting effects play a great part in

Which Kind of a Report to Stockholders?

CENTRAL MAINE POWER COMPANY

To the Stockholders of the Central Maine Power Company:

With this letter goes a check for dividend No. 68 to each one of the eleven thousand people who own the preferred stock of the Central Maine Power Company. For twenty years—at first once in six months and since then once in three months—this organization has been distributing its earnings to an ever-increasing number of people.

At first the checks were few in number and small in amount. The scene of the signing of the checks for the first dividend stands out clearly as though it were yesterday. It was a dark winter afternoon in the old office on a back street in Waterville. Edward L. Meader, long since dead, stood at an old-fashioned upright desk and wrote the checks. Harvey Eaton signed them. It was rather a solemn occasion. The money wasn't so very large in amount, but the business needed it. On the other hand, those who had intrusted us with their money should and must have their share of the return it had earned, and they did. More than that, they have continued to have it ever since.

How that list of checks has grown as the years have slipped by! First it was less than twenty-five. Then it became fifty and so on to one hundred. After I became treasurer and moved to Augusta the signing of the dividend checks was a small matter. It took fifteen or twenty minutes, then half an hour or so, and then longer. By 1917 it had come to be a real job and took the biggest part of several days. In 1918 I delegated my signature to my secretary, and by 1921 it was taking most of her time for two weeks. Now the signatures are affixed by a machine that signs five checks at once, and still it takes several days. . . .

The growth of the business is astonishing. The use of electricity is creeping into the daily lives of people everywhere. More and more people are asking for electric power. And they must have it. Each day brings some new use or a new application of an old one. And doesn't this suggest the end toward which we in the hydro-electric business are working? Is not our task to harness more and more of the power of our rivers and sell more and more electricity until the day when every bit of work in every home and every store and every factory that can be done by electricity is done by our rivers as they flow to the sea?

That is what is going on all over America, and Maine must do her part. We have the rivers and the water powers. It is of the greatest importance that these rivers be set to work as fast as work can be found for them to do.

I believe we are fortunate in having a great co-operative organization like Central Maine with its 250,000 hp. of undeveloped water power, its broad market and its ever-growing business as a medium whereby this work can be accomplished. The state is to be congratulated on having eleven thousand citizens within its borders who have become partners in this most important work.

You, on the other hand, have obtained what I believe to be a safe and profitable investment in a great business. This business, the possibilities of which have scarcely begun to be known, should become vastly greater and of more value as the years roll on. Sincerely yours,

WALTER S. WYMAN, Treasurer.

Oct. 1, 1923.

FOURTEENTH ANNUAL REPORT OF THE AMALGAMATED POWER COMPANY

To the Stockholders:

Herewith is submitted the annual report of the board of directors of the Amalgamated Power Company for the year ended Dec. 31, 1922.

The consolidated revenue account of the Amalgamated Power Company and its subsidiary companies for twelve months ended Dec. 31, 1922, as compared with the preceding twelve months, is as follows:

(Here is given a cold and dreary tabulation concerning income, expense, deductions, interest on floating debt, amortization and so on.)

From the foregoing it will be noted that the operating revenue increased 16 per cent and operating expenses and taxes increased only 12 per cent, making a consequent increase in the operating income of 27 per cent.

There is also appended a comparative statement of income and expenses of the subsidiary companies for the year 1922 as compared with the year 1921.

(This statement under such a name cannot be located in the report.)

Expenditures for improvements and betterments to the plants and properties of the various underlying companies were made amounting to $212,312.43, and $101,821.85 was expended for maintenance and charged into operating expenses. . . .

The books and accounts of your company have been audited by Messrs. Smith & Brown, certified public accountants, whose certificate forms part of this report. Respectfully submitted,

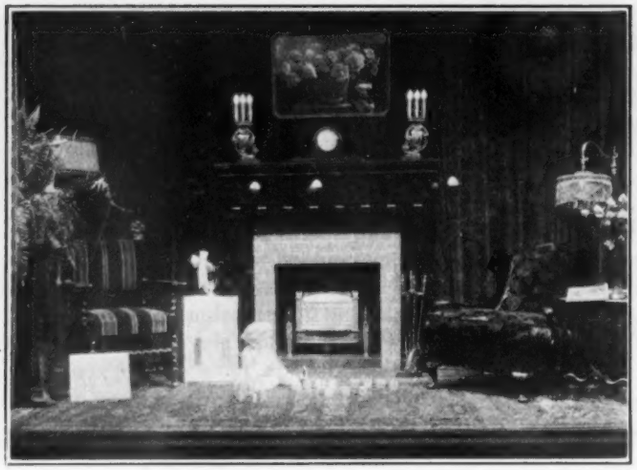
President.

By order of the Board of Directors.

INSTEAD of issuing a formal annual report with the customary financial statement, the Central Maine Power Company takes advantage of the opportunity to communicate with its stockholders four times a year when the quarterly dividend checks are mailed. Each check is accompanied by a letter addressed to the stockholders which relates, in understandable language, the company's activities and progress. The financial condition of the company is shown in a brief statement of earnings and assets also inclosed with the dividend checks quarterly.

The latest letter, which went out with the October dividend, is reprinted here almost in full. It shows how it is possible to weave into the otherwise dry facts a message of accomplishment and a picture of what the future holds in store.

In contrast with this is also printed part of another utility's annual report, chosen at random from a file of several hundred similar missives addressed once each year to stockholders in typical here-it-is-take-it-or-leave-it style. It is quoted verbatim, names excepted.



BLACKSTONE VALLEY COMPANY'S TWO PRIZE-WINNING DISPLAYS IN SHOW-WINDOW CONTEST

any successful display, the commercial lighting department of the company offered to lend the merchants window-lighting equipment of the latest design and advise with them how to use it to increase the value of their displays. This equipment consisted of color screens, reflectors, spotlights, floodlights and lamps.

The displays were classified as to the nature of the merchandise, and the results attained in lighting effects were a revelation to the merchants and public alike. The Blackstone Valley Gas & Electric Company—working on the basis that "seeing is believing" and that the merchant must be shown the value of good lighting—not only won the highest honors, regardless of class of merchandise, but also won first and third prize in the household goods division. The accompanying illustrations show the winning displays as decorated by members of the company's sales department.

A total of 114 entries in the contest indicates the success of the undertaking, and already the commercial lighting department has been asked to co-operate with the Chamber of Commerce in Christmas and spring mercantile events. When the prizes for the contest were awarded it was found that every prize winner with but one exception had utilized some of the company's equipment.

The Blackstone Valley Gas & Electric Company has been so successful in its new service in Pawtucket that the work is being extended to the Woonsocket division. Through the services of its illuminating engineers the company offers specifications and blue-print layouts showing location of outlets and type of units recommended for both new or remodeled buildings. The co-operation obtained from architects and contractor-dealers is rapidly leading to higher standards of illumination in the territories served, and contractors are now not only installing a "wiring job" but are performing a real electrical service.

As the demand for the services of this newly organized department grows, and as its field rapidly develops, future plans call for extending its work into the industrial areas which Pawtucket and Woonsocket represent. Lectures on lighting, included in the annual Chamber of Commerce industrial lecture courses and before existing manufacturers' associations, have been arranged. Demonstrations and exhibits are planned to be given before the school boards, educational and merchants' associations, with a view to raising illumination standards throughout the company's territory.

This work was carried on under the direction of F. C. Eteson, in charge of the commercial lighting department under R. A. Gordon, sales manager of the Blackstone Valley Gas & Electric Company.

What Other Companies Are Doing

Syracuse, N. Y.—The village of Tully, which for twenty years has operated a municipal electric plant, has abandoned the enterprise because of an annual deficit of from one to two thousand dollars. As a result of a recent special election, at which it was voted almost unanimously to sell the municipal distribution system to the Syracuse Lighting Company and to grant a franchise for operation, the village will soon have an improved electric service at a 12-cent rate for residences, compared with 20 cents under municipal operation.

Salt Lake City, Utah.—A special exhibit by the Utah Power & Light Company at the Utah State Fair, held during October, proved to be one of the most attractive features of the exposition. The company's development and utilization of Bear Lake and Bear River waters was presented by means of a panoramic reproduction, molded in plaster, of the lake, the river and contiguous territory, from the inlet and outlet canals and Lifton pumping plant on Bear Lake down to Great Salt Lake.

Des Moines, Iowa.—The women employees of public utility companies in Iowa, Nebraska, Missouri and Kansas have organized for the purpose of studying the principles of better utility service. Representatives from these four states held their initial meeting at Des Moines recently, where they were given an organization instruction by Miss Isabelle Davie, chairman of the Iowa and Middle Western division of the women's public information committee of the N. E. L. A.

Marinette, Wis.—To stimulate added interest in the erection of a more modern street-lighting system where tentative steps have already been taken by the community for such an improvement, and to act as a forerunner to improved and better illumination facilities, the Menominee & Marinette Light & Traction Company has adopted the method of placing various single types of ornamental street-lighting systems on exhibition in the City Hall Square of Menominee. By this plan an opportunity is afforded the citizens to judge which type will be the best suited from an economical as well as a civic improvement viewpoint.

Digest of Electrical Literature

Including Brief Abstracts of and References to
Important Articles Appearing in the Scientific and Engineering Press
from All Parts of the World

Hydro-Electric Development and Steam Equipment

Test Data on Turbo-Alternators.—Very complete test data on a 1,500-kw. turbo-alternator installed at Aylesbury, England, are given. This turbine generates at 6,600 volts, 50 cycles and 3,000 r.p.m. It is of the Curtis impulse type, the steam passing through one compound impulse stage and six single stages. The steam consumption varies from 13.75 lb. at one-half load to 11.9 lb. at one and one-quarter load. —*Electrician* (*England*), Sept. 21, 1923.

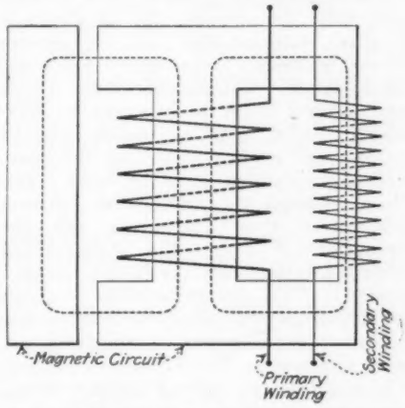
Design of Rotating Disks. — G. ARROWSMITH.—The complete evaluation of the stresses in a rotating disk is a very difficult process, but in view of the present-day tendency toward turbine units of large output running at relatively high speeds it is a problem which has to be carefully considered. Since the grade of steel commercially obtainable for the manufacture of disks has a fairly definite maximum tensile strength, it is essential that the disks be so proportioned that the disposition of stresses will give the highest possible factor of safety consistent with the qualities of material procurable. Various expressions enabling the approximate tangential stress curve to be found show that this curve corresponds to any given radial stress curve. Definite solutions of the differential equations of stress have been obtained only for a few particular cases where the radius and the axial thickness of a disk bear a definite mathematical relationship to each other.—*Engineering* (*England*), Oct. 5, 1923.

Results of Tests Made on Hydraulic-Turbine Governors.—The Pennsylvania Water & Power Company has recently conducted a series of tests on hydro-electric turbine governors. These tests were made to determine how parallel operation of hydro-electric and steam plants 40 miles apart could be improved. Among the elements investigated were the sensitiveness of governors, effects of kinetic energy in the machine's revolving parts and power-system reactance. The plants in which the tests were conducted are connected for parallel operation through four 70,000-volt transmission lines.—*Power*, Oct. 9, 1923.

Choice of Turbines for Hydro-Electric Stations.—G. GAMBARELLA.—In order to get the best efficiency from a hydro-electric installation, it is necessary to determine the type and the fundamental characteristics of the turbines to be installed according to the height of the fall, the quantity of the available water and the most convenient r.p.m. at which the machines will run. Different types of turbines are considered by the author.—*Elettrotecnica*, Oct. 5, 1923.

Generation, Control, Switching and Protection

Protection System for Parallel Feeders.—H. C. A. KORTLANDT.—A system is described which uses straight overload protection at the generating end and power-directional relays at the receiving end of the line. Enough voltage for operation of the power-directional element even under short-circuit conditions is obtained through a small transformer illustrated herewith. Its magnetic circuit is *ID*-shaped, with the primary winding on the thick second leg and secondary winding on the thin last leg. This insures a high ratio at low voltages and a low ratio at higher voltage.—*Sterkstroom*, Aug. 15, 1923.



POWER-DIRECTIONAL RELAY TRANSFORMER OPERATES SATISFACTORILY UNDER HEAVY SHORT CIRCUIT

Continuous-Current Generator for High Voltage.—S. R. BERGMAN.—An abstract of this paper may be found in the ELECTRICAL WORLD report of the A. I. E. E. summer convention, July 7, 1923, page 21.—*Journal of A. I. E. E.*, October, 1923.

Transmission, Substations and Distribution

Reduction of Eddy Losses in Butt-Joint Transformer Cores.—H. KRUZNER.—To reduce magnetizing current of transformer cores with butt joints a very careful finishing of the butting surfaces is essential. This is usually done by a shaping or milling process, followed by grinding. No matter how carefully the final grinding is made, it is impossible to avoid a large number of very fine steel fins, which bridge adjacent laminations and cause undesirable eddies. The author found that a very material improvement can be achieved by etching the butt surface with a diluted mixture of sulphuric and nitric acids, after the grinding process, followed by thorough drying. Practical measurements on a small transformer showed a watt loss per kilogram of iron of 1.98, and after etching 1.44, or a decrease of more than 35 per cent.—*Elektrotechnik und Maschinenbau*, Sept. 23, 1923.

Experimental Alternating-Current Transmission System.—O. R. SCHURIG.—The author deals with a three-phase miniature alternating-current system of the network type used for the practical solution of network and transmission problems. The circuit includes synchronous machines, transformers, adjustable resistors, reactors and condensers for complete representation of generating stations, substations, lines and loads. The connections are variable so that any system having not more than the available number of circuit elements may be represented for the correct experimental solution of low-frequency problems. A brief discussion of some of the present problems called up by the miniature experimental methods, full descriptions of the miniature equipment, an outline of the operating procedure in the solution of problems and an example illustrating the application of the miniature equipment are given. This paper was presented at the summer convention of the A. I. E. E.—*Journal of A. I. E. E.*, October, 1923.

Construction and Care of Distribution Transformers.—L. G. MASON.—For mining service only the highest quality of electrical apparatus should be considered. In this article the author considers the selection of the best transformer for the work, fundamental considerations of the iron and copper losses, method of testing and recommendations as to proper care.—*Coal Age*, Oct. 25, 1923.

Units, Measurements and Instruments

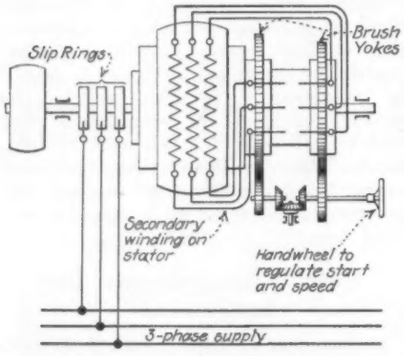
Calibration of Oil-Immersed, Water-Cooled Standard Low-Resistances.—B. G. CHRUCHER.—In the accurate determination of low resistances or large direct currents the measurement is made in terms of standard low resistance. In the best types the resistance material is immersed in oil, and when intended for carrying large currents water cooling is also provided. If it is desired to determine the unknown resistance or current to a high degree of accuracy, it is, of course, necessary to know the resistance value of the standard to a high degree of accuracy under the particular conditions of the experiment. Neglecting very gradual changes of time—that is aging of oil—the direct-current resistance value of a properly designed standard varies with the temperature of the resistance material only. This temperature is, however, affected by a number of factors. The author considers the question of when and under what conditions the standard should be calibrated in order that its re-

sistance value may be accurately ascertained under any subsequent experimental conditions. — *Electrician (England)*, Oct. 5, 1923.

Preventing Theft of Electric Service.—I. CLEMENTI.—The author considers balanced and unbalanced induction meters with diagrams showing how a consumer can steal energy. He then discusses methods of detecting and preventing these thefts. — *Elettrotecnica*, Sept. 25, 1923.

Motors and Control

Motors for the Paper Industry.—O. KESSLER. — Difficult starting and frequent falling out of step are the two main reasons why synchronous three-phase motors have rarely been used for the drive of wood-pulp grinders. The difficulty seems to have been overcome by the development of a type of synchronous motor with asynchronous start. The motor is brought up to speed like an induction motor and synchronizes itself to the line when its field is excited. If an overload exceeds its maximum torque, the motor does not fall out of step, but begins to run asynchronously with a certain percentage of slip. As soon as the load falls off again to the normal rating of the motor it synchronizes itself again. At times of low load the machine furnishes compensating current, acting therefore automatically as



VARIABLE-SPEED COMMUTATOR MOTOR FOR DRIVING PAPER MACHINES

a synchronous condenser. If the motor is chosen larger than the grinder would require, this feature of improving the power factor may be realized even during full-load run. Another motor is described for the drive of paper machines at variable speed. It is a commutator motor with a double set of brushes, as shown in the accompanying illustration. A speed regulation of one to three may be accomplished by simply moving the brush yokes, which may be done manually or by remote motor control. At a given brush position the motor will maintain its speed within 1 per cent or 2 per cent regardless of the load. Sparkless commutation and long wear of the brushes are claimed for this motor, which is well suited for the very exacting drive of paper machines or of machines that require similar speed control.—*Siemens Zeitschrift*, August and September, 1923.

Heat Applications and Material Handling

Welding Cast Iron with a Special Nickel-Copper-Alloy Welding Wire.—A. CHURCHWARD.—Recently there has been developed a successful method of welding cast iron involving a new principle of absorbing the carbon contained in the cast iron, forming thereby at the juncture of the weld a new alloy which not only insures strength equal to that of the original castings but also permits ready machining. This is accomplished without preheating, annealing or the use of studs.—*Journal of American Welding Society*, September, 1923.

Selecting Equipment for Vertical Shaft Hoisting.—M. A. MAXWELL.—Drum shapes, types of electric drive and hoist control equipment are described. There are three types of drums, namely, plain cylindrical, conical and cylindro-conical. The proper and most economical type of drum is readily determinable by calculation from the known data for each specific installation. Before the drum shape and several other details can be definitely decided upon a decision must be made whether the "skip" or the "car-and-cage" system is to be used. The three systems of control and the electric drive that are given are the induction motor, the Ilgner-Ward Leonard system and the Ward Leonard system. The second system employs a direct-current shunt-wound motor operated from a motor-generator set with flywheel by Ward Leonard control. The third system uses a direct-current, shunt-wound motor operated from a motor-generator set without flywheel with Ward Leonard control.—*Coal Age*, Oct. 18, 1923.

Electrophysics, Electrochemistry and Batteries

Magnetic Properties of Atoms.—P. LANGEVIN.—In order to account for magnetic properties it is necessary to assume that each atom or molecule possesses in its normal state a quite definite magnetic moment which is proportional to the total moment of the quantity of electron movement. This moment can be zero when the symmetry of the edifice is sufficient and always becomes modified in the diamagnetic sense under the action of an external magnetic field. From the point of view of classical dynamics a system of electrified particles which participates in thermal agitation cannot exhibit when it is isolated, nor assume, under the action of an external magnetic field, any resultant magnetic moment, and consequently cannot possess any magnetic property. The laws of quanta, on the contrary, allow one immediately to predict the existence of molecular magnetic moments which are integral multiples of the Bohr magnetron, and they alone permit one to develop in a completely coherent manner an electronic theory of magnetism in the same way as they have rendered possible a theory of atomic structure and of the emission of spectra. Magnetic measurements contribute their information regarding atomic structure, and atomic models ought to be in quantitative agreement with them. The family of rare gases seems to give rise to some interesting difficulties from this point of view. The variation of magnetic properties with the state of chemical combination furnishes in like manner important indications and confirmations of the theory. The progressive disappearance of ferro-magnetism and para-magnetism when the magnetic atoms (iron, cobalt, platium, etc.) enter into more and more complex combination shows that chemical affinity tends to constitute molecules with no resultant magnetic moment, i.e., to realize electronic edifices which present a higher and higher symmetry. —*Paper presented before the British Association at Liverpool, England*, Sept. 12-19, 1923.

Telegraphy, Telephony, Radio and Signals

Measuring Very Short Radio Wave Lengths and Their Use in Frequency Standardization.—F. W. DUNMORE and F. H. ENGEL.—The paper describes one method of establishing frequency standards employed by the Bureau of Standards which is based on the direct linear measurement of the wave length of very short standing waves on a pair of parallel wires. The wave lengths measured were from 9 m. to 16 m., the currents having frequencies from 33,000 kilocycles to 19,000 kilocycles per second. The method is also of use for calibrating a wave meter at frequencies from 30,000 kilocycles to 352 kilocycles. —*Proceedings of the Institute of Radio Engineers*, October, 1923.

Axially Controlled Magnetron. — A. W. HULL.—An abstract of this paper may be found in the ELECTRICAL WORLD report of the A. I. E. E. summer convention, July 7, 1923, page 18. —*Journal of A. I. E. E.*, October, 1923.

Miscellaneous

Electrical Structure of Matter.—SIR ERNEST RUTHERFORD.—In this paper the genesis of wireless, the atomic theory, the influence of radioactivity, fixing of the atomic mass, the structure and nucleus of the atom, research on isotopes, energy relations and atomic nuclei are considered.—*Paper presented before the British Association at Liverpool, England*, Sept. 12-19, 1923.

Fire Extinguisher.—F. ANDRESS.—Extended and thorough tests proved to the satisfaction of the author that carbon-tetrachloride is the best fire extinguisher known, especially for quickly putting out burning gasoline, benzol, petroleum, oil and electric arcs in large industrial buildings. It is a non-conductor and quenches flames almost instantly. It is, however, advisable to use this chemical extinguisher only in large and roomy places, because its fumes may otherwise have an injurious effect upon the breathing organisms.—*A.E.G. Mitteilungen*, September, 1923.

Scientific and Industrial Research

A Department Devoted to Reports of Investigations Contemplated or Completed, Research Facilities Available and Suggestions for Co-operative Work

Conducted by PROF. VLADIMIR KARAPETOFF, *Cornell University, Ithaca, N. Y.*

[PRINTED IN THE THIRD ISSUE OF EACH MONTH]

[When investigations which have been completed are, in the opinion of the editors, of wide enough interest to the field we serve, details thereof will be presented in other parts of this paper. Contemplated research or that which appears to have limited appeal will be only briefly reported in this section, but details may be had by communicating with the investigator or institution named in the report. Readers are referred to the department "Digest of Electrical Literature" for investigations reported in other journals. The news and engineering sections should also be followed for research reported before technical societies.]

Research Completed

Brightness at the Melting Point of Platinum

Observations of the brightness of a series of platinum cylinder black bodies at their melting points have been carried out by a photo-electric photometric method. Similar records of standard lamps permit the determination of the quantity in question. The mean value from a large number of melts for the brightness of the black body at the melting point of platinum is 55.4 c.p. per square centimeter, which is believed to be accurate to within 0.25 per cent. The definiteness with which this point may be determined and the relative simplicity of the apparatus required recommend it for consideration as a primary fixed point or standard in photometry.—*Herbert E. Ives, Western Electric Company, New York.*

Busbar Insulators, Concrete Inserts for

The special size and design of the bus insulators for the Queenston power house required a suitable method of fastening these to the concrete floors, walls and ceilings. Ordinarily a metal plug known as an "insert" and drilled to receive a bolt of proper size is embedded in the concrete at the time the concrete is placed. A number of these inserts were submitted to the laboratory for comparative tests, and it was found that the effectiveness of an insert was almost altogether due to the depth to which it was embedded in the concrete and not to any projections or lugs with which it was embellished; that the only projection required was a shoulder on the end inserted in the concrete to prevent the insert pulling out. With this information an insert was designed having a pull-out strength of 16,000 lb. and which could be made from a drop forging at a cost very much less than that of the cast-iron insert ordinarily used. —*Hydro-Electric Power Commission, Toronto, Ont.*

Insulator Testing in Oil

With the usual method of dry testing of insulator units the applied potential is limited by the flashover of the unit, so that it is impossible to test a piece at a higher voltage than that to which it may be subjected in service under abnormal conditions. By immersing the outer rim of the unit in transformer oil the flashover voltage is considerably increased, so that it becomes possible to test units at a higher voltage than that to which they can be subjected in actual service. This method was described in *Trans. A. I. E. E.*, Vol. XLI, page 732, 1922, and has been since found successful in extended practical use.—*G. W. Lapp, Le Roy, N. Y.*

Porcelain, Porosity Test for

An unglazed full-size porcelain is placed in the center sagger on the bottom layer of each kiln car, the position where underfiring will be first apparent. Upon the withdrawal of each car from the kiln the test piece is broken to expose the center and the pieces are placed in a solution of fuchsine dye and wood alcohol. A pressure of 200 lb. per square inch is applied continuously over a period of two hours. After being removed from the solution, dried and broken open, the pieces must show absolutely no penetration of the dye if the porcelain contained on the car is to be accepted for assembly. This test, when used in connection with the proper method of tunnel kiln firing, is most effective in preventing porous porcelain from passing to the assembly room.—*Jeffery-Dewitt Insulator Company, Kenova, West Va.*

Resistances, Standard, Oil Tank for

An oil-immersion tank has been constructed for the standard resistances and arranged for quick and convenient connection of any unit, as required in standardization work. The units terminate in mercury cups and are thoroughly protected from the effects of moisture and other disturbing influences. At one end of the tank is a small circulating pump, which is driven by an outside motor and serves to keep the oil, when in use, at a uniform temperature.—*Hydro-Electric Power Commission, Toronto, Ont.*

Soil Temperature, Measurement of, with Thermocouples

The apparatus for determining subgrade temperature consists of thermocouples, mercury contact panel, constant temperature unit and potentiometer. The thermocouples consist of two wires, copper and constantan (60 per cent Cn, 40 per cent Ni), soldered together and inserted in glass tubes sealed with paraffin. For details see the *Bulletin of the National Research Council*, 1923, Vol. 6, part 4, page 30.—*Arlington (Va.) Experimental Farm.*

Transformer for a Million Volts

The decision of the electrical engineers of the Southern California Edison Company and the California Institute of Technology to have equipment capable of producing low-frequency alternating potentials of 1,000,000 volts between a free and a grounded terminal made necessary a special transformer which has just been completed. It consists of four separate transformers, each of which is placed on an insulating pedestal. The high potential from the first transformer is used to excite the second and that of the second to excite the third, and so on. In this way the voltage is built up to the desired value.—*Royal W. Sorensen, California Institute of Technology, Pasadena.*

In Progress or Purposed

Dams, Arch Type, Investigation of

An investigation on a large scale is to be made of the strength and other properties of arch dams both on models and on actual dams. A special test dam may be built later to be ultimately loaded to destruction. This investigation is to be made under the auspices of the Engineering Foundation, with the co-operation of several power companies, federal, state and municipal authorities, engineering schools, etc.—*C. Derleth, Jr., University of California, Berkeley, Cal.*

Illumination, Its Effect Upon Industrial Efficiency

The advisory board of the Engineering Foundation has received and is thoroughly investigating the feasibility, cost and probability of support of a suggested experimental investigation of the relation of quality and quantity of illumination to efficiency.

Meters, Watt-Hour, Load Curves

A recurring question has been that of the performance of watt-hour meters on extremely light and heavy loads. The deviations from accuracy allowable on light and full loads are definitely specified in the Code for Electricity Meters. However, it seems desirable to bring about an appreciation of the existence of this requirement by a study of load curves of modern meters. Efforts are being made to obtain comparable data on the performance of several types of meters.—*Meter Committee of the N. E. L. A.*

Refractory Materials, Electrical Conductivity of, at High Temperatures

Reliable and comparable data are needed on the electrical resistivity at high temperatures of the refractory materials suitable for furnace linings. Methods and apparatus for making such measurements have been developed and test pieces prepared from fireclay, kaolin, alundum, diaspore, thoria, silica, zirconia, magnesite, silicon carbide, sillimanite, zirkite and magnesium spinel. Resistance measurements have been run on half of the pieces. Carbon electrodes are employed, measurements being run in an atmosphere of pure nitrogen to a temperature of 1,400 deg. C. in a gas-tight platinum-resistance furnace.—*U. S. Bureau of Mines, Ceramic Experiment Station, Columbus, Ohio.*

Tanks for Light Oil, Welded

To overcome the difficulty now experienced in the riveted tank used for holding light oils, specifications have been drawn up for the welding of these tanks. This promises not only a cheaper but also a better storage tank and opens up a new and large field to which welding is particularly adopted. Several small tanks have already been successfully built in this way, and it is estimated that the saving due to the prevention of loss of oil from evaporation and leakage will pay for the welded tank inside of two years.—*American Bureau of Welding, New York, N. Y.*

Suggestions for Research

Electrometer, Quadrant, for Power Measurement

This instrument can be used to advantage in measurements of power factor and effective resistance in actuating-current circuits, especially at high voltages and low values of power factor. It permits the use of null methods of considerable precision. While these methods are familiar to physicists, it is desired to develop and to try them for industrial measurements, especially in cable testing and in the study of dielectrics.—*D. Owen, Physical Society of London*, 1923, Vol. 35, page 140.

Hydraulic Turbines, Runners for

With regard to the pitting and erosion of runners, it may be said that super-turbine development has now reached a stage where this condition is no longer primarily a problem of design but of economics. In other words, the manufacturer can select a specified speed at which the runner will have as long a period of useful life as the other major elements of the installation. Such a specification on the part of the customer would, of course, involve additional capital expenditure for the generator as well as for the turbine, but a modern super-turbine frequently can earn upward of $2,500 every twenty-four hours. Consequently, the lost revenue charge against runner replacement, in a fully loaded unit, may easily run as high as $25,000. It is thus evident that a proper economic specified speed is a factor of at least equal importance with proper gateage, and elevation relative to tailwater.—*H. G. Acres, Hydro-Electric Power Commission, Toronto.*

Light and Music

One of the most interesting phases of the application of colored light is in connection with music. It is a fascinating subject to the experimenter, be he scientist, decorator or musician. To all intents and purposes, it offers a virgin field for constructive effort, and the motion-picture theaters constitute a huge laboratory extending from coast to coast.—*A. L. Powell, Edison Lamp Works, Harrison, N. J.*

Lighting, Mixed, of Sunlight and Artificial Light

In many interiors artificial lighting is used during certain hours to supplement the natural lighting through the windows. It is of interest to investigate the illuminating, physiological and psychological aspects of such a combination under different conditions.

Timing Devices, Electrical

The use of timing devices other than watches is becoming more general, particularly for laboratory work. Some of the difficulties in obtaining measurements of time would be solved by the production of some portable form of timing device, and it is hoped that the manufacturers will direct their efforts to this end.—*Meter Committee of the N. E. L. A.*

News of the Industry

Chronicle of Important Events and General Activities, Announcements and Reports of Association Meetings, Court Decisions and Commission Rulings and News of Electrical Men

Edison Meets Medalists

Six Recipients of the Honor Named for Him Meet Inventor at Luncheon —Replica Given Him

THOMAS A. EDISON and six of the ten living men to whom the Edison medal has been awarded were guests of honor at a luncheon given at the Engineers' Club, New York, on Friday, Nov. 9, by Edward D. Adams, chairman of the Edison medal committee of the American Institute of Electrical Engineers. Others in attendance were the members of the Edison medal committee of award.

The Edison medal was founded upon the initiative of an organization composed of associates and friends of Thomas A. Edison, who subscribed a trust fund for that purpose and invited the American Institute of Electrical Engineers to assume the responsibility of making the awards. By the terms of the deed of gift and the bylaws of the committee this gold medal is awarded each year to a resident of the United States or Canada "for meritorious achievement in electrical science, electrical engineering or the electrical arts." The award, which is one of the highest attainable honors in the engineering profession, is made by a committee of the Institute consisting of twenty-four members.

The medalists who were present were Dr. Elihu Thomson of Swampscott, Mass.; Frank J. Sprague and Prof. Michael I. Pupin of New York, Benjamin G. Lamme of Pittsburgh, W. L. R. Emmet of Schenectady and Cummings C. Chesney of Pittsfield, Mass. The other living medalists, who were unable to attend, are Charles F. Brush of Cleveland, John J. Carty and Nikola Tesla of New York and Robert Andrews Millikan of Pasadena, Cal. Three medalists, George Westinghouse, William Stanley and Alexander Graham Bell, are dead.

Brief reports were made by Past-president Jewett and Secretary Hutchinson on the presentation of the Edison medal for 1922 to Dr. Millikan at the Pacific Coast convention of the Institute, held in Del Monte early in October, on which occasion Dr. Jewett made the presentation address from New York by means of transcontinental telephone lines and amplifying apparatus installed at Del Monte.

Dr. Elihu Thomson, to whom the first medal was awarded in 1909, and Dr. Michael I. Pupin, the 1920 medalist, made interesting addresses with reference to modern research, including recent developments in electron physics. Gano Dunn spoke feelingly of his contact with and the encouragement he received from Mr. Edison in the early days of the speaker's engineering experience and referred to progress in research work affecting the engineering profession.

Mr. Edison Gets Replica

The culminating act at the luncheon was the presentation of a silver replica of the Edison medal to Mr. Edison as a memento of the occasion, this being the only silver medal that has ever been struck from the dies. In presenting this replica Chairman Adams said:

"As an expression of our great pleasure in greeting you here today in our electrical symposium, we hereby present you with a silver medal struck by the United States Mint from the Edison medal dies, expressly as a souvenir for you and as a reminder of the many friends of twenty years ago who made this conference possible, and of those of today who most earnestly wish you a future of comforts, friendship and achievements as you yourself would welcome them as the crowning features of a useful and happy life."

Dr. Millikan Wins the Nobel Prize for Physics

It has just been announced at Stockholm, Sweden, that the 1923 Nobel prize for physics has been awarded to Dr. R. A. Millikan of the California Institute of Technology, winner also of the Edison medal this year.

Street-Lighting Tables for 1924

FOLLOWING its practice for thirty-five consecutive years, the ELECTRICAL WORLD has prepared tables showing the proper time for lighting and extinguishing street lamps. The 1924 tables will be ready in a few days, and a copy will be sent free to any subscriber upon request to ELECTRICAL WORLD, Tenth Avenue and 36th Street, New York. For more than one copy a charge of 25 cents each is made to cover a portion of the postage, printing and compilation costs.

New Jersey with New York

She Follows the Example of Neighbor in Attacking the Federal Power Commission

A MOTION for leave to file an original suit against the Federal Power Commission was presented in the United States Supreme Court by attorneys for the State of New Jersey on Nov. 12. Inasmuch as the questions raised by New Jersey are similar to those involved in the suit of the State of New York against the commission, the action of the Supreme Court on the motion is problematical.

In the bill of complaint which will be filed if the motion is granted and which was included in the printed motion presented to the court New Jersey seeks to enjoin the Federal Power Commission from acting in that state "by abuse of power without lawful and constitutional authority or in pursuance of wrongful and erroneous interpretations of the provisions" of the federal water-power act and asks the court to declare the act unconstitutional.

Dispute Over Morris Canal

The principal complaint of New Jersey is that the Federal Power Commission is attempting to exercise jurisdiction over the state's proposed development of water power along the Morris Canal, which runs from the Delaware River at Phillipsburg to the Hudson near Jersey City. This canal, started in 1824 and operated in recent years by the Lehigh Valley Railroad, was purchased by New Jersey last year, the formal transfer having taken place on March 1. New Jersey plans to develop power at a number of points along the canal, the proposed bill asserts, with dams at Lake Hopatcong and above Saxton Falls on the Musconetcong River and along the Delaware River, various sites being specified. The state has not applied to the Federal Power Commission for permits and does not propose to do so, the bill recites.

Other assertions made in the bill are that the commission is asserting authority over riparian lands which bring revenue to the state for its school fund and that control by the commission also would interfere with the conservation policy of the state over its potable waters and cause heavy loss to investment in waterworks. The authority of the commission over certain streams and to regulate rates for the sale of electric power within the state is challenged.

Farm Engineers on Rural Electrification

One Day's Sessions Are Devoted to Its Consideration at the Chicago Meeting of Society—Representatives of Other Bodies Take Part in Discussion

THE American Society of Agricultural Engineers, which held its seventeenth annual meeting in Chicago last week, devoted the whole of Friday to the discussion of rural electrification. Seven papers were presented on the subject by representatives from the American Farm Bureau, agricultural engineers, the electric utility industry and manufacturers. The United States Department of Agriculture was also represented in the discussion. Activities of the N. E. L. A. committee on rural lines were outlined, the history of work undertaken so far by electric service companies was related, desirable conditions for supplying rural service were suggested, the work of the Joint Committee on Relation of Electricity to Agriculture was outlined, the relation of central-station companies to the movement was discussed, and even the feasibility of obtaining electric power from the wind was considered.

C. A. Atherton, chairman of the committee on rural power lines, gave a general statement of its activities, calling particular attention to engineering, economic, statistical and commercial studies which are necessary. Methods of financing, erecting and operating rural lines, uses to which electricity may be applied in agriculture, nature of equipment for most economical utilization of electricity and energy required for different jobs were cited as subjects for study, mention being made also of equipment design, the number of farms, nature of crops, extent to which power lines are already accessible, amount of power used and purposes for which it is employed.

Past Practices in Rural Service

Except for the greater amount of distribution equipment required per rural customer, G. C. Neff, general superintendent Wisconsin River Power Company, declared, the problem of rural service is not very different from serving urban communities, where the number of customers per mile may be thirty to a hundred as compared with three per mile in the country. If the farmer can be shown any economy in using five to ten times the energy used by city consumers, the prospects of more extensive rural service will become less remote.

Mr. Neff contended that it is best for all involved for the electric service company to operate and maintain rural service lines. There are two general methods of financing, by the customer and by the company. The first method will bring about more rapid development because utilities hesitate to make the investment in most cases because of the uncertainty of adequate return. With increase of energy consumption per customer this condition will change.

Regardless of who owns the rural service lines, they enhance the value of any farm which can be served from them, declared Prof. E. A. Stewart, University of Minnesota. While present conditions exist, however, utilities will be indifferent to rural service in most cases, because it is generally a gamble. While Professor Stewart agreed that the electric service company should operate and maintain the lines, he expressed the belief that farmers can finance them cheaper than can utilities because of the lower interest rate obtainable. Benefits would redound to the farmer and utility, he said, if the latter employed farm labor for erecting the lines and purchased poles from the farmers. Because rural service is a community benefit the general expense should be divided equally between all customers, only long extensions being charged to the individuals benefited. He favored high fixed charges and a low energy rate to make the business profitable to utilities from the beginning and to encourage large use of power. Core-loss energy should be paid for by the individuals, the professor contended. To show the practical application of his ideas Professor Stewart submitted what he considers a model rural-service contract, features of which will be presented in a later issue.

No 5 per Cent Money

Arthur Huntington, Iowa Railway & Light Company, called attention to the public confusion regarding maintenance and depreciation. Furthermore, he contended that 5 per cent money is a myth, pointing out that the farmer has to pay at least 2 per cent more for the handling of a loan. Regarding taxation, he said that the state requires a definite amount of money for operation, and it has to be provided by the public whether it pays the taxes or the utilities do.

G. C. Neff thought that no trouble should be experienced in applying rural service rates to late comers if the rate schedules and the boundaries of the district coming under them are filed with the state commission.

In answer to queries raised regarding the great diversity in rate schedules, J. C. Martin explained that they were developed in the early stages of central-station operation and have been so closely woven into the industry that they cannot be radically revised in a short time without friction, although most utility men will admit they are inadequate for changing conditions. He criticised a plan proposed in Professor Stewart's rural-service contract for the same reason, saying that provision should be made for periodic adjustment and that it should not be made unchangeable for twenty years as proposed.

The organization and plans of the Joint Committee on Relation of Electricity to Agriculture were outlined by J. W. Coverdale, its chairman. (These plans have been covered in past issues of the ELECTRICAL WORLD and an interesting phase is discussed on page 1016 of this issue under the heading "Experimental Electrical Farms in Minnesota.") Mr. Coverdale contended that investigations conducted by agricultural engineers as to the maximum economical use of electricity on farms would be the greatest single influence in bringing about a greater degree of rural service.

Utilities' Attitude on Problems

M. H. Aylesworth, executive manager of the N. E. L. A., said that the work of the joint committee is in no way an exploitation of the farmer. The best proof of this is that the demands for power are already beyond the capabilities of production. Central stations will not seek business before it is forced on them. The only selfish interest which they have is to bring about customer ownership of utility stocks so that the public will investigate their problems and give utilities a fair deal. Furthermore, he pointed out that the utility companies do not want equipment imposed on farmers which is not suited to their use. Greater standardization of equipment must come, and some electrical manufacturers have already indicated their desire to co-operate. Power lines are spreading out so that the country must come to interstate, rather than state, regulation, Mr. Aylesworth declared. He expressed the opinion that unit farm electric plants are the forerunners of service from power lines, although they may become relatively uneconomical after rural service is obtainable. He urged establishment of rural service experiment stations at all agricultural colleges.

Electric Power from Windmills

Results of tests to determine the feasibility of obtaining electric power for farm operation from windmill plants were presented by Prof. F. C. Fenton, Iowa State College, who referred to an extensive investigation at Ames, Iowa, with a 14-ft. windmill geared forty to one to a 36-volt generator charging a 240-amp.-hr. battery. It was found with this plant that the generating range falls between wind velocities of 8 miles and 32 miles per hour, lower velocities not being sufficient to generate any power and greater velocities putting the mill out of action. At 12 miles per hour this particular mill generated 10 amp., although variations ranging from 2 amp. to 25 amp. may occur in a few seconds because of gusts. The summer calm, Professor Fenton said, is a serious obstacle to windmill generation.

Professor Stewart announced that one wind-power generator costs $1,500 to $1,900 installed and that the watt-hour efficiency of storage batteries, according to tests, ranges from 61 to 75 per cent.

Utility Men Discuss Electrification

Superpower, Rural Service, Public Relations, Finances and Commission Regulation Are Topics at Well-Attended Meeting at Charleston, W. Va.

MORE than 150 representatives of the public utilities of the state attended the annual meeting of the West Virginia Utilities Association in Charleston on Nov. 9 and 10. Several notable papers were presented and much constructive work was done.

At the opening session on Friday S. Q. Hayes of the Westinghouse Electric & Manufacturing Company presented a paper on superpower and railroad electrification. He said that West Virginia's enormous coal deposits and water-power possibilities make it a pivotal point for superpower development. Superpower, Mr. Hayes continued, is being realized now. The Virginian Power Company is arranging for or considering tie connections at suitable points with the Appalachian Power Company, the Kentucky-West Virginia Power Company and possibly others. The lines of the West Penn Power Company or the American Gas & Electric Company may later form connecting links in a 132-kv. system that will tie together Charleston, Wheeling, Pittsburgh, Cleveland and other industrial centers. Mr. Hayes then discussed the electrification projects of the Norfolk & Western and the Virginian railways. The latter, he said, is today operating the heaviest trains in the world with the most powerful steam locomotives, but to provide still greater transportation facilities electrification has been determined upon. Power for the Virginian electrification will be supplied from a steam station on the New River at Narrows. The initial capacity of this plant will be four units, each with a maximum rating of 15,000 kw., which will be sufficient for handling approximately double the present tonnage.

Interchange of Railway Power

As the Virginian Railway and the Norfolk & Western Railway parallel each other for a considerable distance on either side of the New River and are only a short distance apart at other portions of their lines, the use of the same general scheme of electrification on the two lines will permit the ready interchange of power between these systems in case of necessity and will allow each system to act essentially as spare capacity for the other.

There is a tie connection between the Appalachian Power Company and the Norfolk & Western Railway through the frequency-changer equipment at Switchback, and there may be a similar connection with the Virginian Railway. The probable interconnection between the Appalachian Power Company and the Virginian Power Company at Scarbro, West Va., and the future tie connections between the Virginian Power Company, the Kentucky-West Virginia Power Company and other power systems may ultimately lead to a general interconnection of the railway and power systems throughout West Virginia and the neighboring states.

In addition to the Norfolk & Western and the Virginian railways, Mr. Hayes said that the Baltimore & Ohio has been seriously considering electrification of certain portions of its lines in West Virginia. At present the general limiting conditions for the Baltimore & Ohio Railway are not due to conditions on the railway lines as they exist in West Virginia, but to the terminal facilities at the ports on the Atlantic seacoast. Particular sections in West Virginia can be greatly improved by electrification. In a somewhat similar manner, terminal facilities for the Chesapeake & Ohio Railway are possibly limiting features rather than its lines in West Virginia. However, when the terminal facilities of the Baltimore & Ohio and the Chesapeake & Ohio at seaboard have been increased it will then be advisable to increase their railway facilities.

At the afternoon session J. A. Morris, district manager of the American Railroad Association, reviewed the transportation situation.

Utilities' Future Problems

W. B. Clarkson presented a paper on creating favorable public sentiment. The future, he said, presented two problems—first, the adequacy of earnings on plant put in at post-war prices when existing rates are based on pre-war plant and, second, the obligation of utilities to meet the demands for service. New capital in great quantities must be supplied by the public. Publicity, customer ownership, co-operation of employees and good service were the essential aids.

Major Alexander Forward of the Virginia Corporation Commission predicted a bright future for the utilities and held that no better method had been devised to secure proper development than regulatory commissions.

At an evening banquet Martin J. Insull made an excellent address on the two most important problems facing the utilities. In his opinion an enlightened and sympathetic public opinion was a fundamental necessity of prosperous utility growth. He outlined methods to bring this about. The other great problem, in the opinion of Mr. Insull, was to obtain adequate funds to permit the utilities to realize the opportunities for service. With financing rates are bound up.

Rural Service

On Saturday a series of fifteen-minute talks were given on various phases of utility business. A. H. Grimsley, general manager of the Virginia-Western Power Company, presented a paper on rural service in which he gave the main features of the rules proposed for Virginia. In view of the great interest now being taken in rural service, these summaries of the rules are printed here:

First—The term "rural customer" refers to the farmer or other consumer of electrical energy who is not within the corporate limits of any city or town or any other territory having similar character or density of population.

Second—When one or more prospective rural customers make a request for electric service the utility will investigate the extension, ascertain the number of customers who can be advantageously served and the number willing to contract for service under the terms prescribed, and will estimate the construction cost.

Third—Construction cost should be divided into two classes:

1. Cost of general equipment, which includes cost of all labor and material directly chargeable to the rural extension from the point where this extension originates to the local equipment on the customer's premises. Items of freight, cartage, purchasing and storeroom expenses should be included, to which should be added a proper percentage covering engineering and superintendence, etc.

2. Cost of local equipment should include all cost of labor and material required for the installation of step-down transformers supplied customer, together with secondary wires, services, protective apparatus, etc., including freight, cartage, purchasing and storeroom expense, to which should be added a proper percentage for engineering and superintendence.

3. Meter equipment will be supplied by the utility at its own expense.

Fourth—Prospective customers shall pay the utility the estimated cost of the general equipment, together with the estimated cost of the local equipment, the latter to be apportioned in accordance with the expenditures required for the various individual customers.

Fifth—An additional rural customer will be connected to an extension upon the payment of a connection charge plus the cost of the local equipment necessary to serve him. This connection charge will be determined by dividing the total cost of general equipment of the original extension by the number of original customers. If the cost of general equipment required to serve the additional customer is less than the connection charge, the additional customer shall pay the connection charge and the cost of local equipment, whereupon the utility will make the connection. The difference between the connection charge and the cost of general equipment shall be refunded to the customers on the extension (including the additional customer) in proportion to the amounts advanced.

Sixth—Rates for rural service shall be regular city rates plus a rural charge. This rural charge shall cover the amount by which the fixed charges, energy losses and operating expenses incident to rural service exceed the corresponding items for equivalent revenue from said rates.

Seventh—The rural charge is arrived at in the following manner: Ten per cent of the total construction cost of the extension plus the total transformer core losses computed at 1½ cents per kilowatt-hour minus 27 per cent of the annual revenue from the extension resulting from the application of regular city rates.

(Note.—For rural extensions the items of depreciation, taxes, excess operating expenses, hazards, etc., have been found to be equal to about 10 per cent of the construction cost as follows: Excess maintenance and operating expenses, 4½ per cent; depreciation, 4 per cent; taxes, 1½ per cent. City rates are designed to cover taxes, depreciation and return on the investment in the city distribution system as follows: Taxes, 1½ per cent; depreciation, 4 per cent; return, 8 per cent; total, 13½ per cent on the investment. The average investment in city distribution system is equal to about twice the annual revenue. These fixed charges carried by city rates can, therefore, be expressed as 27 per cent of the annual revenue.)

Eighth—Adjustments will be made in the rural charge at the end of each calendar year to allow for changes and number of customers, revenue from line, etc.

Ninth—When the capacity, size or character of any general or local equipment needs to be increased or changed in order adequately to take care of the rural service customer or prospective customer whose requirements necessitate the change, pay for the same. Apportioning of such payments shall be the same as for new extensions.

Tenth—The title to all extensions, whether on private property or public highways, shall be vested in the utility.

Swope Gives First Aldred Lecture at M. I. T.

Gerard Swope, president of the General Electric Company, as stated last week, addressed the faculty, postgraduate and senior students of the Massachusetts Institute of Technology at Cambridge, Nov. 9, upon "The Engineer's Relation to Society," this being the first of a series of lectures provided for by J. E. Aldred. In a brief introductory talk Mr. Aldred emphasized the vital importance of common sense in engineering and the need of persistence.

Mr. Swope pictured the benefits conferred upon society by the engineer as illustrated in the development of hydroelectric energy, by the reclamation of arid wastes through irrigation, and by the improvement of industrial processes through electrical applications. Discussing the problem of management and labor, the speaker drew a broad sketch of the opportunities before the modern engineer in the direction of bringing about improved relationships and increasing the efficiency of production, pointing out that high wages and low costs are not inconsistent, provided production is at a maximum. Production at lower cost spells progress to civilization, and the engineer is, he said, better fitted to undertake this work, including that of industrial relations, than any other professional man.

The next lecture will be on Nov. 23, by Julian C. Smith, vice-president Shawinigan Water & Power Company, Montreal, on "The Development of a Water Power." John W. Lieb, vice-president New York Edison Company, is scheduled to speak on Dec. 7.

Weeks Leases Sheffield Plant to Alabama Power

The Sheffield steam plant at Muscle Shoals has been leased for another period of a year to the Alabama Power Company, which has been operating it. Secretary of War Weeks, in announcing recently that the lease probably would be renewed, said it would continue to be revocable. Thomas W. Martin, president of the power company, said his company would pay the government $350,000 for the use of the plant this year.

Good Attendance and Program for Supply Jobbers

The annual winter meeting of the Electrical Supply Jobbers' Association, held at the Hotel Statler, Buffalo, this week, attracted the largest attendance for years. Executive committee and merchandising committee meetings were held on Monday and Tuesday, executive sessions on Wednesday and open meetings on Thursday. Excellent addresses were given, including "Credit and Collection Conditions," by Frederic P. Vose, general secretary National Electrical Credit Association; "The Radio Situation," by David Sarnoff, vice-president Radio Corporation of America; "The 'If' in Electrify," by O. Fred Rost, Newark, N. J., and "Contrast Between Jobbing Electrical Supplies and Hardware," by H. O. Smith, Akron, Ohio.

President Nicholson Reviews Work of A. M. E. S.

In connection with the section meetings of the Associated Manufacturers of Electrical Supplies in New York on Nov. 7 to 9 a general meeting of the association was held, at which matters of common interest to all sections were discussed. S. L. Nicholson, president of the association, who presided, reviewed broadly the general work of the association. It is anticipated that the new organization and working rules will facilitate the work of the association and the sections on matters of standardization. He outlined the procedure of the American Engineering Standards Committee.

Work of the Electrical Manufacturers' Council, in which the Associated Manufacturers of Electrical Supplies is one of three member bodies, and of some of its most active committees was also discussed by Mr. Nicholson. He directed attention to the importance of the activities of the casualty and fire prevention committee and to the taxation committee and the newly authorized industrial relations committee.

Mr. Magnus W. Alexander, National Industrial Conference Board, discussed the problems handled by that organization in matters of taxation and immigration and labor.

Other features of the association work were presented by Thomas M. Debevoise, the counsel of the association, and C. A. Bates chairman of the committee on rules of procedure.

S. E. D. Directors Meet

Plans for Greatly Increased Membership Bear Fruit—Revenues Have Been Tripled

THE concurrent meetings of the board of directors of the Society for Electrical Development and the Advisory Publicity Council functioning for the S. E. D. and the Joint Committee for Business Development were held in New York last week, when W. L. Goodwin and F. M. Feiker, the operating vice-presidents of the society first named, presented reports of various developments.

Full discussion took place over the plans for greatly increased membership in the society. In this discussion it developed that it has not been generally realized that the annual dues have been reduced more than 50 per cent in the last two years, and that the present budget of the society, while more than three times the total collected on original dues, actually represents less than half the cost to each individual member. In other words, the membership has increased enough to triple the revenue of the society.

DIRECTORS OF THE SOCIETY FOR ELECTRICAL DEVELOPMENT LEAVING ELECTRIC TAXIS

Reading from left to right, they are H. B. Crouse, Crouse-Hinds Company, Syracuse, N. Y.; Fred Bissell, F. Bissell Company, Toledo, Ohio; James Smieton, Jr., secretary-treasurer, S. E. D.; E. W. Rockafellow, National Pole Company, New York; J. Robert Crouse, Crouse-Tremaine-Kulas Company, Cleveland; James H. McGraw, McGraw-Hill Company, New York; F. M. Feiker, operating vice-president S. E. D.; Frank D. Van Winkle, Post-Glover Electric Company, Cincinnati; W. I. Bickford, Iron City Electric Company, Pittsburgh; W. H. Morton, Sanborn Electric Company, Indianapolis; L. P. Sawyer, National Lamp Works, General Electric Company, Cleveland; John F. Gilchrist, Commonwealth Edison Company; J. E. Montague, Niagara Electric Service Corporation; C. L. Edgar, Boston Edison Company, and W. L. Goodwin, operating vice-president S. E. D.

Davenport Opposes New Dam in Mississippi

Considerably more hydro - electric power will be developed at Davenport, Iowa, if a dam across the Mississippi on which United States Army engineers have been working goes through as planned. The dam, however, would close the channel of the Mississippi River since it is designed to rise 7 ft. above the low-water mark, and such opposition from Davenport, Bettendorf and Princeton has arisen that the project may be stopped. Davenport asserts that its water supply would be threatened, and a state investigation is to be made.

At the present time a dam extends up river from Rock Island. This dam runs parallel to the Illinois shore. At right angles to this dam, at its up-river end, a second dam runs out into the river. This wing dam is opposite the mouth of Duck Creek, a stream entering the river from the Iowa side. On the Iowa shore below the mouth of Duck Creek a second wing dam runs out into the river. The government engineers had begun to close the gap between these two dams.

This move would have diverted into the Moline pool or canal all of the water coming down stream except during high-water stages of the river. The Moline pool furnishes the "head" for the Davis hydro-electric plant, which sells its power to the Moline Rock Island Manufacturing Company, which in turn sells to the Tri-City Railway & Light Company, the parent company and the main cog in the United Light & Railways Company. The Moline pool also furnished the head for the government hydro-electric plant on Rock Island. The arsenal there is at the present time almost shut down and its surplus power is sold to the Moline Rock Island Manufacturing Company. The Moline pool also constitutes a canal by which steamboat traffic passes around the rapids which stretch up river from Davenport for several miles.

Hetch Hetchy Committee Reports to City

That the city of San Francisco should petition the California Railroad Commission to prepare a valuation of selected portions of the distributing systems of the Pacific Gas & Electric Company and of the Great Western Power Company within the city was the recommendation presented to the San Francisco Board of Supervisors by the citizens' advisory committee on Hetch Hetchy power. The committee did not recommend further attempts to purchase either of the systems at the present time.

The committee announced that the city will have a power house generating 70,000 kw. by Jan. 1, 1925, and that the city will also have a transmission line leading into San Francisco by that time. The recommendation was made that the city refrain from entering into any contracts for the distribution of the power by any private corporation.

At a meeting of the Board of Supervisors it was unanimously agreed to call upon the Railroad Commission to make the valuations suggested by the advisory committee.

Stratton Talks of Europe

Closer International Co-operation Between Engineers a Vital Factor in Maintaining World Peace

"A MORE intimate interchange of ideas and a closer co-operation between scientific and technical men in this country and their professional brethren in foreign lands will tend more than any other factor to promote international peace," declared President S. W. Stratton of the Massachusetts Institute of Technology to a representative of the ELECTRICAL WORLD a few days ago. Dr. Stratton recently returned to Cambridge after a summer vacation in Great Britain and on the Continent, during which he visited a number of educational and research institutions. He made the foregoing observation in response to an inquiry as to conditions overseas in engineering education and research.

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S. W. STRATTON

Referring briefly to engineering education, Dr. Stratton said that England, France and Germany are thoroughly alive to the importance of technical instruction and that not even the difficult economic conditions prevailing in these countries has halted such training. The necessity for adequate general training before specialization is, as in America, widely recognized. During the war many technical institutions gained valuable additions to their equipment. These are now available for service and constitute a sort of surplus of *materiel* which is being turned to excellent account in instruction and investigations. Hard-pressed as Germany is at present, technical education is being kept up, and to many boys whose families have been unfortunate financially engineering training and daily sustenance are being given by the authorities. This care of individuals led Dr. Stratton to touch upon the importance of opening the doors of intensive expert training to exceptional young men in America by the removal of certain pecuniary handicaps which in many cases impair the opportunity such men might otherwise embrace to develop to the full their capabilities for very unusual and exceptional accomplishment. The establishment of a discretionary fund without "strings" attached would make this possible.

INTERCHANGE OF POST-GRADUATES

The interchange of graduate students between America and Europe, said Dr. Stratton, is being advocated more and more overseas, and the exchange of technical professors, it is felt, should be brought about and will yield as valuable results as the well-tested exchange of teachers of non-technical subjects. The work of the Scandinavian Foundation in New York is most promising in this direction. Germany and France are both interested in graduate student interchange with America and are taking steps toward its effective establishment. Dr. Stratton pointed out the deep interest manifested by engineering societies abroad in all phases of trade and technical training. These organizations of engineers are solicitously concerned in the educational facilities available to even the humbler workers in the engineering industry—an interest which might well be duplicated more generally among similar organizations in America.

Going beyond this desirable international liaison between educational institutions, one finds in the professional engineering societies here and abroad means for promoting international understanding that have so far been relatively unused in comparison with the possibilities. Interchanges of view, the sharing of information and experiences by scientists and engineers and the development of international relations on a fact-finding rather than a fundamentally political basis will do far more, in Dr. Stratton's opinion, to insure peace than the diplomacy of self-seeking statesmen. This international contact includes the field of research, in which Great Britain and Germany are and long have been keenly interested, toward which France is turning with ability, and which has attained of late so rapid a development in the United States. The worldwide need of research for government and for industry demands a far greater supply of qualified specialists than are at present receiving adequate training. Industries throughout the world will do well to make more comprehensive provision for research and for the extremely technical training demanded of those who participate in it. Progress hinges upon a liberal policy, through which science will attain new triumphs in the service of humanity.

Ample Program for Southeastern Division, N. E. L. A.

Thirty-one addresses and papers, in addition to the reports from officers and committees, are scheduled for presentation at the four-day convention of the Southeastern Geographic Division, N. E. L. A., which is to be held at the Hillsboro Hotel, Tampa, Fla., on Monday to Thursday of next week, Nov. 19-22. There will be general, technical, commercial and accounting sessions, as follows:

GENERAL SESSIONS

Monday, 2 *p.m.*—Address by Mayor and response by T. W. Martin, president Alabama Power Company; address, W. R. Sammons, president Knoxville Power & Light Company; reports by officers and safety committee.

Tuesday, 10 *a.m.*—Public Relations Section in charge. Reports by P. S. Arkwright, chairman of section, by public-speaking committee and by women's committee on public information; addresses by Ross Murphy, George Oxley, W. H. Hodge, E. F. Wickwire and Chairman H. T. Sands of the Public Relations National Section.

Wednesday, 10 *a.m.*—Addresses by M. H. Aylesworth, C. B. Scott, T. J. McManis, H. M. Atkinson and M. R. Bump.

Thursday, 10 *a.m.*—Addresses by R. Hudson Burr, chairman Florida Railroad Commission; A. J. Maxwell of the North Carolina Corporation Commission and F. M. Feiker of the Society for Electrical Development.

TECHNICAL SESSIONS

Tuesday, 2 *p.m.*—"Carrier-Current Telephony for Power Systems," C. C. Jackson; "Lightning-Arrester Grounds," H. M. Towne; "Demand Meters," W. A. Gentry; "Carrier Systems from the Standpoint of Co-ordination," H. S. Osburn; "Our Neighbors on the Highway," K. L. Wilkinson.

Wednesday, 2 *p.m.*—"Three-Wire Railway Distribution," C. E. Bennett; reports by the meter, inductive-co-ordination and electrical apparatus committees.

ACCOUNTING SESSIONS

Tuesday, 2 *p.m.*—Reports of committees: Budget, classification of accounts, customers' records and billing methods, accounts payable records, fixed capital records, payroll standardization, purchasing and storeroom accounting.

Wednesday, 2 *p.m.*—Report on merchandising accounting; round-table discussion.

COMMERCIAL SESSIONS

Tuesday, 2 *p.m.*—Address by F. P. Cummings, chairman of section; reports of Lighting and Appliance Bureaus: "Building the Domestic Lighting Load," D. A. White; "Merchandising with the Local Contractor-Dealers," J. S. Sutherland; "The Electric Range as a Revenue Builder," I. H. Morchead; address, S. A. Chase.

Wednesday, 2 *p.m.*—Reports of Power Sales Bureau and customers relations committee; "Service to Municipal Pumping Plants," G. S. Jones, Jr.; "Industrial Heating," P. E. Shacklett; "Training Salesman," Martin L. Pierce; "Selling Service to the Public," W. R. Waggoner; address by F. P. Cummings, chairman of section.

Empire State Association's Electric Meeting

The Empire State Gas and Electric Association, which will henceforth hold the annual meeting of its Electric Section in the fall instead of the spring to avoid any possible conflict with the National Electric Light Association convention, has arranged the following program for the first of these fall meetings, to be held in the Edison Club auditorium, Schenectady, next Wednesday and Thursday, Nov. 21-22:

WEDNESDAY, NOV. 21

Morning.—"Essentials of a Modern Distribution System," H. W. Watt, chairman distribution lines committee; "Cost of Joint Line Construction in Rural Districts," J. C. Robbins and A. W. Underhill, chairman rural transmission committee; report on public relations from the New York State Committee on Public Utility Information.

Afternoon.—"The Underground Network System of the United Electric Light & Power Company," C. T. Sinclair; "High-Tension Cables," L. A. Zima, Brooklyn Edison Company; "Is the Overhead Ground Wire Necessary?" C. A. Bacon, chairman transmission lines committee.

THURSDAY, NOV. 22

Morning.—Report of water-power committee, Franklin J. Howes; "Interconnection," E. P. Peck, chairman committee on interconnection; "Methods for Phasing Generators and Transformers to Insure Parallel Operation with Rest of System," A. C. Jordan, chairman operation committee.

At 2:30 p.m. on Thursday an inspection trip will be made to the new Rotterdam substation of the Adirondack Power & Light Corporation.

Public Service of Colorado's Stock-Selling Campaign

The Public Service Company of Colorado launched a ten-day "whirlwind" campaign on Nov. 10 to sell 10,001 shares, or $1,000,000 par value, of its preferred stock to its employees and the public in the territory it serves. This is the first stock sales activity since the recent consolidation of the Denver Gas & Electric Light Company and the Western Light & Power Company of Boulder into the Public Service Company of Colorado, with headquarters in Denver. The price will be 93½, making the yield about 7½ per cent. The stock will be sold by the employees and the local banks on a commission basis.

Brief News Notes

Montreal Light, Heat & Power Plans New Plant. — It is reported from Montreal that the Montreal Light, Heat & Power Consolidated is planning a new plant, which is likely to have an ultimate capacity of 100,000 hp. According to the report, the new plant will be built at Lachine, on the edge of Montreal Island.

Interstate's Purchase of Jeffersonville Company Approved.—Authority to buy the Jeffersonville Water, Light & Power Company has been extended by the Indiana Public Service Commission to the Interstate Public Service Company. The Interstate is to pay $168,750 cash and the $98,500 indebtedness.

Iowa Company to Serve Nine More Towns.—As soon as a transmission line connecting Volga City and Elkader, Iowa, can be constructed, the Northeastern Iowa Power Company will begin to serve nine more towns in that vicinity with electric service, this company having entered into a contract with the People's Electric Service Company of Elkader to furnish the latter with energy for Elkader and eight other places.

Electricity Supersedes Gas in Port Townsend, Wash. — The Washington Coast Utilities has discontinued the manufacture of gas at Port Townsend, Wash., and electric cooking and heating service is now furnished instead. This change ensued on the acceptance of a contract submitted to the City Council, the company agreeing to compensate customers for their gas equipment, now rendered useless.

Vernon (Tex.) Citizens Advocate Sale of New Municipal Plant.—Citizens of Vernon, Tex., have fathered a proposed ordinance by which that city would sell its new municipal electric plant to the Vernon Electric & Ice Company, which, the committee estimates, could serve the city at a large saving to the taxpayers as compared with the operation of a city plant. The city has just been halted in its efforts to finance the plant by an injunction from the Court of Civil Appeals based on contentions of illegality.

New Plant for Middle Georgia. — Engineers have started a survey near Macon, Ga., for a 13,000-hp. generating plant on which work will start within three or four weeks, it has been announced by L. A. Magraw, manager of the Macon Railway & Light Company. The plant will provide power for industrial operations in the Middle Georgia territory and will cost $1,500,000 or $2,000,000. It will serve as an auxiliary plant to the Central Georgia Power Company's hydro-electric plant at Jackson, Ga.

Utility Course of University of Arkansas.—The College of Engineering of the University of Arkansas, Fayetteville, Ark., has just given its sixth special utility men's course under the direction of W. B. Stelzner, professor of electrical engineering. The first four courses were given for metermen. Last year the work was confined to steam practice, and this year the course dealt with general electrical practice.

Indiana Electric Rates Ordered Cut.—The Northern Indiana Gas & Electric Company, under an order of the Indiana Public Service Commission, will reduce its energy rates in Hammond, Whiting and East Chicago on Dec. 1. It is estimated that the new rate will entail an annual saving of $110,000 to consumers, being divided between residential and commercial users in the proportions of $75,000 and $35,000 respectively. This Indiana utility is under the control of Samuel Insull and his associates, who purchased the property last June from the United Gas Improvement Company, which still retains an interest.

Birmingham Company Reorganization.—Further steps have been taken by the receivers of the Birmingham Railway, Light & Power Company toward the payment in full of its main bonded indebtedness, and complete reorganization is expected to come soon

after Jan. 1, following the maturing of the $4,600,000 refunding and extension mortgage 6 per cent bonds, which is definitely indicated as a result of the federal court directing the receivers to make default of payment of interest due.

An Oklahoma Company Changes Name.—The name of the Lawton & Duncan Electric Company of Lawton, Okla., has been changed to the Southwestern Light & Power Company, according to an announcement by President E. R. Ernsberger of Oklahoma City. The company has expended approximately $300,000 on the steam plant at Lawton, including the installation of a new turbine, and 100 miles of high-tension lines will, is is expected, soon be constructed.

Terms of Cahokia Lease Altered.—The petition of the Union Electric Light & Power Company of St. Louis to lease the new Cahokia plant owned by a subsidiary of the North American Company has been amended following the rejection of the original petition by the Missouri Public Service Commission on the plea by the city of St. Louis that under its terms power consumers would not benefit from a reduction in construction costs. The new application provides that if construction costs are reduced the customers and not the company shall reap the advantage.

Pan-American Commission to Promote Intercontinental Electrical Communication.—Secretary of State Hughes has been authorized by the governing board of the Pan-American Union to appoint a special committee to fix a date for a meeting at Mexico City early next year of the Inter-American Electrical Communication Commission. The commission, which will be composed of not more than three delegates from each member state of the Pan-American Union, will, as its name implies, meet for the purpose of developing closer cooperation between the American republics by cable and wireless.

Fynn-Weichsel Motor Exhibited at St. Louis Electrical Board of Trade Meeting.—Although normally discussion of a specific product manufactured by a member company is strictly forbidden by the St. Louis Electrical Board of Trade, an exception was made in the case of the Fynn-Weichsel motor on Nov. 6, it being considered of such far-reaching importance to the electrical industry that the Wagner Electric Corporation was permitted to exhibit it, and the whole session was devoted to a discussion of its merits into which competing companies entered in a broad-spirited way.

Rail Electrification Plans in New York City.—As a preliminary to carrying out the electrification of its lines within the limits of Greater New York in accordance with an act of the last Legislature which makes electrification by Jan. 1, 1926, compulsory, the New York Central Railroad has asked the Transit Commission to order the elimination of all the railroad's grade crossings on the western edge of the city. If this is done, the state and the city must bear jointly half the expense, the railroad bearing the other half. The New York Central maintains that the abolition of grade crossings must precede electrification.

Another Iowa Utility Purchase.—The Iowa Railway & Light Company of Cedar Rapids has bought the property of the Springville Electric Company, Iowa, and will make it a part of its system. The people of Springville at a recent election refused to vote a bond issue for the building of a municipal electric lighting plant.

Ford's St. Paul Plant.—The Ford Motor Company, it is announced, has made all major decisions as to the layout of its Mississippi power and manufacturing plant to be built at the government dam at St. Paul. Modifications in the power-house substructure, built by the government, which were found necessary to take advantage of later developments in waterwheel design are nearing completion. The changes will permit installation of modern turbines and, besides improving flow conditions, will increase efficiency. The hydro-electric development is the company's most extensive undertaking of this kind. The power house will be 160 ft. long by 74 ft. wide and 48 ft. above the foundation. Four waterwheels of 4,500 hp., in conjunction with four vertical generators, under normal conditions will produce approximately 18,000 hp. A steam-power house will be erected to supplement the water power in case of emergency.

North Carolina Companies Expanding.—The Carolina Power & Light and its auxiliary, the Yadkin River Power Company of Raleigh, N. C., are extending their operations in the eastern section of North Carolina by purchase, according to Paul A. Tillery, vice-president of the Carolina company. The Carolina company has purchased the Franklin Light & Power Company of Franklinton, and the Yadkin company has bought the Carolina Electric Company of Maxton. Both the purchased companies have heretofore purchased power from the Carolina and Yadkin companies, distributing it in their respective towns for lighting, heating and small industrial purposes. Under the terms of the purchase the purchasers will retail power in the affected communities as well as wholesale.

Constantinople Turns to Electricity.—Constantinople, with a population of 1,200,000 persons of seventeen different nationalities, is the last large city in the world to take up electricity, the recent announcement of the installation of electric street lighting and street cars marking the final triumph in that city of modernity over superstition and inertia. A central station has been built near the Golden Horn to generate energy, 27 miles of single-track street railroad now carry the inhabitants back and forth, and electric street lights have been set on poles, each of which is surmounted with the national fez and crescent.

Associations and Societies

Denver Electrical Co-operative League.—The organization, purpose and general field operations of the Electrical Co-operative League of Denver were recently discussed before seventy-five representatives of the Denver central-station company by S. W. Bishop, executive manager, and Frank J. McEniry, field representative of the league, with the object of acquainting the central-station employees with the work and problems of the league.

Accounting Section, N. E. L. A.—The Accounting National Section of the N. E. L. A. will hold group meetings at the Hotel Muehlenbach, Kansas City, Mo., on Dec. 10, the following committees being scheduled to meet at 10.45 a.m.: Budget, classification of accounts, customers' records and billing methods, fixed-capital records, merchandise accounting, mortgage and trust agreements, payroll standardization, preservation of records, purchasing and storeroon accounting, security holders' records. At 9.30 a.m. on both Dec. 10 and Dec. 11 there will be a general meeting, and at 2 p.m. on Dec. 11 the section's executive committee will meet.

Coming Meetings of Electrical and Other Technical Societies

[A complete directory of electrical associations is published in the first issue of each volume. See July 7 issue, page 56, for latest list.]

Electric Power Club—French Lick Springs Hotel, French Lick, Ind., Nov. 19-22. S. N. Clarkson, B. F. Keith Bldg., Cleveland.

Southeastern Division, N. E. L. A.—Hillsboro Hotel, Tampa, Fla., Nov. 19-22. Charles A. Collier, Georgia Railway & Power Company, Atlanta, Ga.

Electrical Credit Association, Central Division—Hotel LaSalle, Chicago, Nov. 20-21. F. P. Vose, 1341 Marquette Bldg., Chicago.

Commercial National Section, N. E. L. A.—Group meetings, Salt Lake City, Nov. 21-22.

Empire State Gas and Electric Association—Electric Section, Edison Club, Schenectady, Nov. 21-22.

American Physical Society—Ryerson Physical Laboratory, Chicago, Nov. 30-Dec. 1. H. W. Webb, Columbia University, New York.

American Society of Mechanical Engineers—New York City, Dec. 3-6. C. W. Rice, 29 West 39th St., New York.

National Association of Railway and Utilities Commissioners—Hotel Urmey, Miami, Fla., Dec. 4-7. J. B. Walker, New York Transit Commission, New York City.

Accounting National Section, N. E. L. A.—Hotel Muehlenbach, Kansas City, Dec. 10-11.

American Engineering Council (F. A. E. S.)—Washington, Jan. 10-11. L. W. Wallace, 26 Jackson Place, Washington.

American Institute of Electrical Engineers—Midwinter convention, Philadelphia, Feb. 4-8. F. L. Hutchinson, 33 West 39th St., New York.

Commission Rulings

Obligation to Serve Chartered Territory.—A public service company, said the Pennsylvania Public Service Commission in adjudicating a complaint against the People's Natural Gas Company, is obliged to supply service within its chartered territory and to make at its own expense all reasonable extensions therein for that purpose, where the loss which would have to be passed on in the way of increased rates to other patrons of the company would be comparatively insignificant.

Reparation for Charges Found Unreasonable After They Had Been Paid.—The Pennsylvania Public Service Commission has declared the Phoenixville, Valley Forge & Strafford Electric Railway Company entitled to reparation from the Philadelphia Suburban Gas & Electric Company in the amount of the difference between charges paid under a rate schedule and charges later found to be reasonable by the commission, there being an absence of countervailing evidence and complaint having been filed by the consumer before the effective date of the schedule.

Property Used and Useful.—Land and a cottage occupied by a company employee were included by the Missouri Public Service Commission in the property used and useful of the People's Gas & Electric Company of Chillicothe, Mo., since the occupancy of this property eliminates the expense of employing a watchman and, in addition, is a source of revenue. An appraisal by commission engineers, based on the average of opinion of local real-estate dealers, was considered the best evidence of the value of lands. It was an error, the commission said, "to add to the amount taken as the fair present value of the lands the further sums calculated on that value which were embraced in the items of 'engineering superintendence,' 'legal expenses,' 'contingencies' and 'interest during construction.'"

Bills and Schedules—Change to Meter Service.—In settling a complaint made against the Branchville Electric Power, Water & Light Company, the New Jersey Board of Public Utility Commissioners decreed that bills rendered for past electric service in accordance with schedules should be paid, notwithstanding that the schedules were not filed with the commission and the consumer alleged lack of notice. The adoption of a schedule of meter rates for electric service which has been furnished at flat rates must, the commission said, be determined by the selection of a schedule which has apparently been equitable in communities of a somewhat similar character and size, since it cannot be based upon a valuation of the property coupled with a study of earnings and expenses, owing to the fact that operating costs for unmetered service are likely to be quite different from such costs after meters are installed.

Massachusetts Commission Approves Large Stock Issue.—To facilitate financing now under way at the Weymouth (Mass.) generating plant and other improvements, the Massachusetts Department of Public Utilities has approved the issue by the Edison Electric Illuminating Company of Boston of 64,881 additional shares of capital stock at $140 per share. The yield from the anticipated sale is $9,083,340. The commission found that the price fixed "is not so low as to be inconsistent with the public interest," and while refraining in view of the pending rate case from passing upon the expenditures represented by outstanding notes exceeding the above yield, declared itself satisfied with the proposed issue and declined to override the judgment of the company that stock should be issued at this time rather than bonds.

Recent Court Decisions

California Budget Bill Did Not Impliedly Repeal Section of Utilities Act.—The Railroad Commission of California applied for a writ of mandate against Riley, State Controller, owing to a disputed interpretation of a budget law passed by the Legislature. The California Supreme Court has found that this law did not, as contended, impliedly repeal the section of the utilities act appropriating to the Railroad Commission fund fees directed to be collected by the commission, but merely required the appropriation by previous statute to be used first. (218 Pac. 415.)

Claim for Reparations Not Defeated Because Contract for Service Is Discriminatory.—The Supreme Court of Illinois, in Jefferson Deposit Company vs. Central Illinois Light Company of Peoria, has reversed a decision of the lower court which upheld an order of the state commission. The commission refused to entertain a petition from the Jefferson Deposit Company for a refund of amounts charged in excess of contract rates for steam heating, the commission asserting that the contract was discriminatory. The court holds that a discriminatory contract can be attacked only by methods prescribed in the public utilities act and that a contract for service by a utility cannot be set aside by inference or as an incident to a proceeding on a petition seeking a different relief. Until a contract has been properly set aside any charge above the amount specified in it is an "excessive charge" under the act and a basis for a claim for reparations. (140 N. E. 817.)

What Is the Essential Element of a Public Utility?—Declaring a water-supply business carried on by one Richardson not a public utility, though the California Railroad Commission had held it to be such, the Supreme Court of California said: "To constitute a true public utility the devotion to public use must be of such character that the public generally, or that part of it which has been served and which has accepted the service, has the legal right to demand that that service shall be conducted, so long as it is continued, with reasonable efficiency under reasonable charges." (218 Pac. 418.)

Court Should Not Refuse Utility Permission to Amend Pleading Raising Question of Confiscatory Character of Rates.—The Supreme Court of Ohio, in United Fuel Gas Company vs. City of Ironton, overruled the lower court, which refused to the company permission to amend its plea. This, the Supreme Court held, was an abuse of the discretion lodged by the statutes in the court because in the proceeding referred to the confiscatory character of the rate in dispute was a proper issue, and if determination of such issue should result in a finding that the rates were confiscatory, the denial of leave to amend would amount to a denial of the rights of the utility under the Fourteenth Amendment. The court also decreed that under the state law neither a city nor a public utility company can contract as to the price of the commodity furnished for a longer period than ten years. (140 N. E. 884.)

Oklahoma Commission's Regulation of Ice Companies Upheld.—A petition from the Oklahoma Light & Power Company of Holdenville for a writ of prohibition against the Corporation Commission of the state restraining it from assuming jurisdiction over the prices charged for ice by that company was denied on Oct. 30 by the Oklahoma Supreme Court, which upheld the right of the commission to regulate an ice business as to rates and practices where the facts disclose that it falls within the provisions of the anti-trust act of 1908. This decision is of vital interest to electric utilities in the South and Southwest engaged in the commercial manufacture of ice. The act cited provides in substance that any public business is subject to regulation by the state when it has a virtual monopoly. About two years ago the Corporation Commission assumed jurisdiction over a number of ice companies under the provisions of the act, and the suit just decided was brought as a test case. It is interpreted to apply to all electric light and power companies which manufacture and sell ice.

*The left-hand numbers refer to the volume and the right-hand numbers to the page of the National Reporter System.

Men of the Industry

Changes in Personnel
Accomplishments, Responsibilities, Honors, Appointments and Activities of Men
Engaged in all Branches of the Electrical Industry

Frank H. Gale Receives New Appointment

Frank H. Gale, who for the past seventeen years has been in charge of the space advertising of the General Electric Company, has been assigned to the staff of Dana R. Bullen, assistant vice-president. Mr. Gale will assist Mr. Bullen in the many activities of his new work and especially will have charge of conventions and exhibits with the title of manager of conventions and exhibits.

F. H. GALE

The change will be effective Dec. 1. Mr. Gale was in the service of the Thomson-Houston Company at Lynn, Mass., when it was merged into the General Electric Company in 1892. His work took him first to Schenectady and then to various parts of the country, but he returned to Schenectady in 1895 and four years later was transferred to the commercial department. In 1901 he had charge of the company's interests at the Pan-American Exposition at Buffalo, and since then he has had supervision of such work at all exhibits and conventions. Subsequently he was placed in charge of the company's advertising in periodicals, and later he received the title of advertising manager. Mr. Gale is a member of the N. E. L. A., the A. E. R. A., the Association of National Advertisers and the Engineers' Club and an associate member of the A. I. E. E.

R. J. Snare has been made efficiency engineer of the Texas Power & Light Company at Waco, Tex. Mr. Snare has had considerable experience in power-plant operation and construction and goes to Waco from the test course at the Lynn works of the General Electric Company.

J. D. Farmer, formerly associated with the South Bend office of the Indiana & Michigan Electric Company, has been made manager of the company's new-business department at Elkhart, Ind.

William N. Fenninger, who recently resigned his position of expediting engineer with the Brooklyn Edison Company, is now supervisor of electrical courses at the Mechanics' Institute, Rochester, N. Y.

T. L. Beauchamp, formerly district manager of the Alabama Power Company at Decatur, Ala., is now superintendent of the Tuscaloosa Railway & Utilities Company, Tuscaloosa, Ala., of which property the Alabama Power Company recently took control.

Benjamin Shertenlieb, chief engineer of the Cape May (N. J.) Light & Power Company, which is controlled by the American Gas & Electric Company, has been transferred to the Atlantic City Electric Company, also an A. G. & E. property.

Francis Tingley, formerly supervisor of overhead lines with the Washington Railway & Electric Company, Washington, D. C., has resigned to become a member of the firm of Over & Tingley, to engage in general engineering work in the vicinity of Philadelphia.

D. E. Byerley, formerly general manager of the Hattiesburg (Miss.) Traction Company, a Doherty property, has been transferred to the Lenawee County Gas & Electric Company, Adrian, Mich., recently purchased by the Doherty organization.

Carroll A. Dean, merchandising manager of the Connecticut Light & Power Company, Waterbury, Conn., has resigned to enter the waterworks field at Pepperill, Mass. Mr. Dean was formerly manager of the Pepperill Electric Light & Power Company, which was merged into the Middlesex County Electric Company, and prior to that was appliance sales manager of the Cambridge (Mass.) Electric Light Company.

Frederick W. Carlson, who until recently had been connected with the Westinghouse Electric & Manufacturing Company, is now associated with the Skagit River development of the city of Seattle, Wash., as electrical engineer.

R. G. Manifold and **C. O. Poole** have reopened their engineering offices in Los Angeles, where they will do a general consulting engineering business, including hydraulic, electrical and mechanical engineering, designing and supervising, making examinations, reports and appraisals.

S. L. Pearce of Manchester, England

S. L. Pearce, consulting and chief electrical engineer and manager of the Manchester Corporation Electricity Department, Manchester, England, was born at Crewkerne, Somerset, in 1873. He received his technical education at Finsbury Technical College under Prof. Silvanus P. Thompson and later gained the honorary degree of master of science from Manchester University. Mr. Pearce served as assistant engineer with the British India Steam Navigation Company and subsequently with the Metropolitan Electricity Supply Company and the British Thomson-Houston Company in the same capacity. He then became superintendent engineer with the Central London Railway Company. Affiliating himself with the

S. L. PEARCE

Manchester Corporation as deputy chief electrical engineer, he was advanced to the position of chief electrical engineer and is at the present time consulting and chief electrical engineer and general manager.

Mr. Pearce is a past-president of the Incorporated Municipal Electrical Association, past-president of the Institution of Civil Engineers (Manchester Section) and past-chairman of the Institution of Electrical Engineers (Northwest Territorial Section). He is a member also of the Institution of Mechanical Engineers and a fellow of the American Institute of Electrical Engineers. Mr. Pearce has taken an active part in the movement which led to the legislation for improving the national electricity supply of his country.

W. H. Warner has been made superintendent of aerial construction of the New York & Queens Electric Light & Power Company, succeeding **E. M. Anderson**.

E. R. Dickerson, superintendent of the Cedar Valley Electric Company at Hampton, Iowa, has resigned to go to Uniontown, Pa. Mr. Dickerson's successor at Hampton has not yet been named.

William B. Anthony has been appointed manager of the Shawnee (Okla.) Gas & Electric Company to succeed C. B. Owens, resigned. From 1919 to the spring of this year Mr. Anthony was city manager at Walters, Okla., where he had charge of the local electric light and power plant.

Ralph Lillie, who has been in charge of the purchasing department of the Wisconsin Valley Electric Company at Wausau for many years, has assumed the division managership of the company's properties at Tomahawk, succeeding M. R. Frederickson.

Valère A. Fynn has recently opened offices in St. Louis as a consulting engineer and patent adviser. Mr. Fynn has had thirty years' experience in the design and development of mechanical and electromagnetic apparatus, in manufacturing, consulting engineering and in patent work in the United States and Europe.

Frank H. Schubert, district manager of the Wheeler Condenser & Engineering Company, and **William G. Christy**, secretary of the St. Louis Section of the American Society of Mechanical Engineers, formerly with the St. Louis Boat & Engineering Company, have organized the Schubert-Christy Construction & Machinery Company with offices in St. Louis. The new firm will render general engineering service and specialize in the design and construction of water-cooling equipment for refrigerating and power plants, design of special machinery, process development and construction work.

Walter J. Rey, formerly with the Chicago, Milwaukee & St. Paul Railway Company, is now connected with the Allis-Chalmers Manufacturing Company's electrical department.

P. M. Duncan has severed his connection with the Hawthorne plant of the Western Electric Company to become development engineer with the Allen-Bradley Company, Milwaukee, Wis.

Walter R. Roxbury has left the engineering department of the New York Edison Company to become an engineer in charge of the public utilities division, power plant equipment, of the McIntire Corporation, Newark, N. J.

David S. Brigham, formerly treasurer of the Tri-City Electric Company, Newark, N. J., has been appointed treasurer of the Southern New England Electric Company, electrical supply jobber, with headquarters at Hartford, Conn.

Clark A. Terry, formerly construction engineer with the General Electric Company, Schenectady, N. Y., has become superintendent of the Sherman Island Hydro-Electric Development Company of the International Paper Company at Glens Falls, N. Y.

C. O. Mailloux, consulting engineer of New York, sailed for Europe on Tuesday, Nov. 13, on the Aquitania to attend the second international conference on electrical superpower systems, to be held in Paris from Nov. 27 to Dec. 1.

W. E. Wickenden to Direct Technical Education Investigation

William E. Wickenden, assistant vice-president of the American Telephone & Telegraph Company, has been appointed director of the investigation of engineering education about to be conducted by the Society for the Promotion of Engineering Education with the appropriation made for that purpose by the Carnegie Corporation of New York. Details of the organization and program of the investigation appeared in last week's issue of the ELECTRICAL WORLD.

Mr. Wickenden is well qualified for the work he has been chosen to conduct, for since 1917 he has been engaged in a study of educational and personnel problems. In that year he made a study of personnel problems for the engineering department of the Western Electric

W. E. WICKENDEN

Company which led to the creation of a personnel department, of which he became manager in 1918. During that year he served also as supervisor of personnel methods for the Students' Army Training Corps. In 1921 he was transferred to the headquarters staff of the American Telephone & Telegraph Company as assistant vice-president in charge of the recruiting and development of supervisory and technical personnel for the group of companies making up the Bell System. This work included the promotion of relations with universities and colleges throughout the country.

Before affiliating himself with the Western Electric Company, Mr. Wickenden spent four years at the University of Wisconsin as student and later instructor in physics and electrical engineering and nine years as assistant professor and associate professor of electrical engineering at the Massachusetts Institute of Technology. Mr. Wickenden is chairman of the educational committee of the A. I. E. E., of the committee on relations with engineering colleges of the American Management Association and of the committee on business training of the S. P. E. E.

Dana Pierce, formerly a vice-president of the Underwriters' Laboratories, has been elected president of this organization, succeeding the late William H. Merrill.

C. A. Bacon has been appointed electrical engineer of the Adirondack Power & Light Company, with offices at Schenectady, N. Y.

C. B. Wright, formerly connected with the Duquesne Light Company, Pittsburgh, is now with the Kansas Gas & Electric Company, Wichita, Kan.

Ralph W. Eaton, public service engineer for the city of Providence, was recently elected president of the Providence Engineering Society.

Robert Timmons of the Kansas Gas & Electric Company of Wichita, Kan., was elected president of the Kansas Public Service Association at its recent twenty-sixth annual convention in Lawrence.

Sidney K. Wolf, who recently resigned his position with the Westinghouse Electric & Manufacturing Company, is now connected with the Sheffield Scientific School of Yale University as an instructor in electrical engineering.

Leland B. Bonnett, formerly connected with the General Electric Company, New York, has become associated with the Brooklyn Edison Company, Brooklyn, N. Y., as inside plant engineer.

Dean K. Chadbourne, manager of the department of the Far East of the Westinghouse Electric International Company, recently sailed from San Francisco to make a survey of business conditions in the Far East. Mr. Chadbourne will visit Japan, China, the Philippine Islands, Java, Australia and New Zealand. He will assist other Westinghouse officials in co-operating with the Japanese in the reconstruction of the area devastated by the recent earthquake and fire.

Frederick W. Bliss, representative of the Edison Lamp Works of the General Electric Company, was recently elected vice-president of the Providence (R. I.) Engineering Society.

E. G. Willson, who for several years has had charge of the Valentine Clark treating plant, has associated himself with B. J. Carney & Company, producers of Western red-cedar poles, as treating engineer.

David D. Gibson, Jr., who has been employed in the capacity of field engineer for Sanderson & Porter at Williamsport, Md., has been transferred to Springdale, Pa., in the same capacity.

C. M. Bunnell, general sales manager of the Torrington (Conn.) Company for almost two years, has resigned his position, effective Dec. 31. Previous to his connection at Torrington Mr. Bunnell was director of sales of the Splitdorf Electrical Company. He was also formerly with the General Electric Company as sales manager of the Edison Lamp Works' automobile department for about fourteen years.

Manufacturing and Markets

Devoted to the Discussion of Business and Economic Problems of the Producer and Distributor, with Market Reports, Trade Activities, Foreign and Construction News

Gaining a Place in the Buyer's Mind

The Competition Between the Things One Desires and Those One Needs—"Straight Selling" Too Costly—Electrical Salesmen Must "Play for Place" Also

By Roy Frothingham

IT IS not the competition of similar appliances that need concern any particular manufacturer or distributor of electric ranges, clothes-washing machines, vacuum cleaners, or other appliances. It is the competition of entirely different articles and ideas, all bidding for a share of the money which the good home manager squeezes out between the millstones of income and operating expense.

For every dollar thus saved there are from one to twenty uses. Consciously or otherwise, the average woman has a mental list of things she wants for the home. She has them arranged in order of importance to her. She may desire an electric washer or ironing machine, but as likely as not from one to five other things take precedence. Furniture, musical instruments, rugs, kitchen equipment, china, clothes and an automobile all run in competition with the electric washer and electric ironer. Competitively the advantage is with articles that give comfort or pleasure such as a victrola, a new davenport, furniture, a piano and a parlor rug.

When it comes to convenience and labor-saving articles, there is the competition of the kitchen cabinet, whose advantages are never permitted to get far out of the housewife's thoughts. Likewise the enameled-steel gas range with oven-heat regulator, the sanitary ice box with cork insulation, aluminum ware, oven glassware and enameled utensils. These and similar articles are attractively presented so as to preoccupy the niches of her mind. It is entirely possible for minor items of household equipment to gain and maintain precedence over major electric appliances.

There is a streak in most of us that encourages us to labor on in dull and unimproved fashion so long as we can balance the monotonous routine of work by pleasant diversion. Many a merchant has an automobile but not a cash register. And many a woman will wash clothes all morning without complaint so long as she can later delight herself with the harmony of music and the beauty of pretty furniture.

MANY manufacturers of electrical appliances — likewise jobbers and dealers who distribute and sell them—are overlooking or disregarding an interecting and most important point that bears directly on their market. Being electrical men, they accept the idea of using electrical labor savers in the home (although, alas! they themselves actually may not use many) and they get into the habit of expecting the average householder who represents the market for the goods to think the same way—which he does not. In this article Mr. Frothingham, for some time an electrical man and now in the general advertising field, discusses the competition of other devices that cause the housewife to hold a viewpoint quite different, thus hampering the sale of electrical equipment to the American home.

A handsome rug or a mahogany table to win the admiration of a neighbor may mean more to her than an efficient washer in the basement. For the home is one place where the light of attractive furnishing will never be hidden under a bushel.

There are those in the appliance industry who believe that theirs is a straight selling business—a man-power, house-to-house, unending solicitation business where enough men making enough calls will sell enough washers. They believe that each woman without a washer has got to be "sold" individually on the idea of doing the washing electrically at home. To persuade her and to get action requires a man who can get inside the door, demonstrate his machine, get her to move the electric washer idea from number six in her mind to number one, and get a first payment with a signed installment contract. The man who can get inside the door and get his washer idea a front seat in her mind will sell his machine regardless of make, style or price.

But this method is amazingly expensive in terms of salesmen, selling price, commissions and increasing indifference on the part of women to the salesman who calls. It is very expensive in terms of dealer discontent. It is expensive in terms of consumer objection to prices that seem unreasonably high—an objection which, when coupled with prejudice or indifference to electric washing and ironing, seriously affects the whole appliance business from factory production to consumer selling.

If the idea of electric washing at home is a good idea, and if it is deserving of as much consideration by women as other ideas such as those concerning linoleum, rugs, furniture, kitchen cabinets, piano and phonograph music, house heating, hardwood floors and open plumbing, then certainly the electric washer idea deserves adequate treatment along lines of educational publicity such as are used in co-operation by manufacturers of davenport beds, wall paper and hardwood floors and by the associated commercial laundries.

There is both tendency and temptation among electrical men to assume that all women are attracted by the electric washer and ironer idea and that it is simply a matter of getting the "down" payment and installing the machine. Opinion here depends on what is meant by getting an idea "sold." A real selling job these days, whether it be selling Eskimo pie or electric washers, requires steady, hard-hitting publicity to pave the way for salesmen and back them up and persuade

women to put electric washers, ironers and ranges at the top of their shopping lists without granting precedence to anything else. As things stand now, the appliance industry is granting precedence to a whole league of articles, some of which are mentioned in this article. *What* a woman thinks and *when* she takes action depend on how the electrical man maintains his place in her mind.

Business Conditions

A Survey of Important Developments in the Electrical Market Including Data on Production, the Sales Outlook, Credits, Exports, the Metals and Other Conditions Affecting Cost, Supply and Demand

REPORTS from important electrical centers of the United States show some contrasts in the business as a whole. In a number of items production and distribution are at high levels, while in other lines one or the other of these factors is below normal conditions. The present lack of balance in the market is indicated by an unprecedented demand for all household appliances and novelties, while the industrial side of the industry is left with few orders of importance. The situation has been of this character for a number of weeks, although the general market has seen continued improvement. Power equipment is fair, with a slacking off in transmission towers and equipment.

An interesting development of the week is the increased buying power in the agricultural districts as reported by the large mail-order houses of the country. Sales of farm-lighting sets are improving in the Southeastern section and in New England, but no special activity is reported in any other territories. In the East sales of electrical merchandise and supplies are running substantially above last year's figures, but are not up to the majority quotas set last January. Central-station expansion in the East continues strong, mostly in connection with extensions and with building operations.

In the South manufacturers report excellent sales of outdoor transformer equipment, with deliveries running at from five to six months. Smaller sizes are running from six to sixteen weeks. Turbo-generator sales in the South are smaller than expected. In the Middle West the demand for rubber-covered wire has been enlivened by small price reductions effected several weeks ago. Transformers there have been reduced approximately 10 per cent owing to increased manufacturing facilities. Cautious rubber-covered wire buying is reported on the West Coast, where, as in other sections of the country, household appliances are attracting most attention.

Record Electrical Toy Sales Expected in Retail Trade

RECORD sales of electrical toys will be made in the retail trade during the coming holiday season if the volume of sales by the manufacturers to jobbers and dealers is taken as an index for estimating the volume of retail turnover of this merchandise. The electrical toy situation is greatly improved over that of 1922 and 1921 in that the manufacturers received many easy orders during the spring and early summer which enabled them to start production promptly and arrange for shipping the goods soon enough to meet the requirements of the retail trade.

One manufacturer of electrical railway trains and toy motors, commenting on the improved conditions in the industry resulting from the placing of early orders, said that because orders were placed with his firm during the spring months it had been possible to keep prices down in spite of increases in labor charges and materials. Continuous production enabled his company to reduce certain elements of factory cost enough to offset these increases in expense.

More than $7,000,000 worth of electrical toys was bought from the United States for the children of the world during 1922, and it is conservatively estimated by the makers that the retail value for 1923 will certainly reach $10,000,000. It is pointed out that during recent years there has been a remarkable development in the toy industry, the product of a marked change in the character of playthings for older children. This has come about in response to the demand for toys for both boys and girls with which they can do something useful and with which they can develop their minds. Today children are gaining knowledge from their electrical cooking sets, electrical railways, motors, sounding devices, batteries and miniature lamps, and all of the other playthings in a long list of practical toys which only a short time ago no one would have dreamed of buying for these youngsters before they entered high school.

One of the questions asked the electrical toy manufacturer is, "What toy or novelty is making the biggest hit this year?" It is the opinion of these manufacturers that there are no overnight successes in the toy industry. Toys have been an evolution from the crude beginnings of savage times. The process of improvement and development is the same as with appliances used in the home, office and factory. A little refinement here, a little change there, year by year, with no great difference at any one date, but in a generation the dealers' shelves show that a complete change has taken place. Occasionally there comes a new toy which is as totally different from the old toys as the automobile was from the horse and wagon, but both came because there was need for them. The iron train which ran when pulled by a string changed into the mechanical train operated by clockwork. This was followed by the appealing reproduction of the latest electrical railroad equipment.

An interesting aspect of toy buying is the fact that children are outgrowing the novelties faster than they did years ago. This tendency is the same in the educational institutions, since subjects that were once taught only in colleges are now taught in high schools and the former high-school courses are getting into the grade schools. Toys that a few years ago might have been appropriate for children of nine and ten years are now demanded by younger children. There is also a growing appreciation on the part of children of quality in toys, just as the fathers and mothers are buying better office and domestic appliances, rugs, furniture and pictures.

Farmers' Increased Buying Power to Help Lighting Plants

ALTHOUGH reports from manufacturers of farm-lighting equipment contain little news in the way of increased sales, an interesting indication of the farmers' returning purchasing power may be gathered from the October reports from the mail-order houses. Several of the largest mail-order houses in Chicago state that their sales for last month have been larger than those of any preceding month in 1923 and that the gains over the same period in 1922 range from 25 to 50 per cent. The farm-lighting-plant manufacturers are considering this evidence of increased buying power by the farmers as an excellent barometer of what they may expect in business for 1924.

The general farm-lighting-unit situation does not appear to have changed much during the past summer and early fall. The hoped-for opening up in business this fall or early winter has not appeared. Others who have felt this slump in the agricultural districts are the automotive industries, the implement manufacturers and the general construction field. Although the present buying is largely in the corn belt of the Middle West, average conditions have been general during several months, and it is difficult to say which territory is leading. A great deal of selling effort is still required to "sell" the farmer. Two years ago a farmer would mortgage unmarketed crops to make purchases, but today he waits until he has the actual money in his pockets to do with as he chooses.

Few price changes are contemplated because of the fairly stable prices of raw materials. Little decline in the costs of distribution, advertising and other sales effort can be expected. In

all cases where questions of high prices are discussed manufacturers are stressing their services which are available after the equipment is once sold and the high cost of which will tend to keep prices at the present levels. Manufacturers' stocks are ample to meet most demands since a close connection with this field has prevented overbuying of raw materials. While the manufacturers are not over-optimistic, there is little pessimism to be heard today because it is generally felt that once the farmer gets firmly established on his feet he will be in a position to take advantage of all the pioneering work and salesmanship which the farm-plant makers are expending at this time.

Rapid Development of Industrial Heating Devices Continues

RAPID development of new industrial electric heating devices continues to be a striking feature of the market for this class of apparatus. Progress in their application is somewhat handicapped by the lack of interest a good many central-station companies show in the subject, although conditions are far better than a few years ago. Utilities with sales engineers thoroughly informed as to the latest developments in such appliances for factory, mercantile, bakery and laboratory service are building up a fund of valuable experience which is making it easier to deal with this steadily increasing demand, but companies which have displayed a long-standing indifference to the possibilities of industrial electric heating are still far too many.

Manufacturers are now prepared to supply a liberal range of apparatus of reasonably standard characteristics for general industrial heating service along well-tried lines. Along with this growth of demand for standardized products goes an interesting and a suggestive development of equipment for new and particular uses. The marketing of many of these devices is still a matter of sales engineering, but more and more the products of wider application are tending toward the staple class, and the outlook for this branch of the appliance and apparatus trade is very bright.

Considerable Improvement in New York; Wire Orders Fall

CONSIDERABLE improvement is seen in this week's New York electrical market, but outside of the domestic appliance field there seems to be little buying for future needs. Conduit is still selling steadily, but is said to be without feature. The change in wire prices two weeks ago is believed to have cut off some interesting orders pending at that time, and although there is a great volume of material proceeding to the recently constructed apartment houses and office buildings, little new business in wiring materials came in during the week.

Sales for the year are above those for 1922, but are not up to the quotas set by jobbers last January. The heavy holiday buying of this season is expected to add at least 15 per cent to the general business accomplished during the third quarter of the year. A slight pick-up in the motor market for the textile field for replacements and repairs was reported during the week. Lamps continue to sell at an unprecedented rate, which is the result of five or six newspaper campaigns by jobbers in all boroughs.

New England Trade Volume Well Ahead of 1922

SALES of electrical merchandise and supplies in New England are running substantially above last year's figures, although it is not expected that the final quarter will show as large a margin over the corresponding months of 1922 as was the case during the summer. Present indications favor a 10 per cent gain in representative jobbing circles on gross business between Oct. 1 and Dec. 31 inclusive. Wholesale collections have improved within the past four weeks. A heavy volume of appliances is moving into electrical retail stores in anticipation of the holiday trade.

Central-station expansion continues most active, notably in connection with building operations. The latter totaled $31,157,000 in New England for October, a gain of 29 per cent over September, and 18 per cent over October, 1922. Important new office-building construction in Boston is a feature of the present situation, involving extensive installations of electrical material. High-tension cable deliveries are now much shorter than a few weeks ago. Some improvement is evident in the New England textile industry. Other industrial conditions appear healthy in the Northeast, and popular interest in kitchen-lighting campaigns is mounting rapidly.

Chicago Trade Trends Upward; Transformers Reduced

THE electrical trade in Chicago has experienced another good business week. There have been no remarkably large orders placed, but the aggregate total is satisfactory. The demand for rubber-covered wire has been very good, accentuated, no doubt, by the reduction in prices a short while back. Conduit sales have kept up to their previous good record, as many manufacturers report from 25 to 50 per cent more tonnage shipped than at this time last month and that the unfilled orders on their books are equal to those of a month ago. There seems to be no indication at present that there will be an immediate advance in price. The high-tension-equipment sales and pole-line hardware demand are good, although the number of orders placed for pole-line hardware equipment has fallen off.

The only important price change is on transformers. Potential transformers were reduced in price virtually 10 per cent. This was effective about Nov. 7. The reason stated is that increased manufacturing facilities have enabled transformer manufacturers to reduce their prices. It is felt that loom is likely to advance soon, but no higher prices are being asked at the present time. Building activity is continuing, and the prospects are that this month will surpass October, even though October had an exceptionally large number of building permits.

Atlanta Reports 5 per Cent Wire Cut; Lamps Gain 20 per Cent

ELECTRICAL jobbing lines are holding up well, and the electrical retailers report a satisfactory business, though the holiday buying has not yet started. One jobber announced a 5 per cent price reduction on copper wire, effective this week. Lamp sales are approximately 20 per cent in excess of those this time last year, but on account of the reduced prices the money volume is about the same. However, prospects are bright for big business in this item during the winter.

That conditions in the rural districts are getting on a better plane is indicated by the increasing interest that the farmers in the Southeast are showing in labor-saving devices. Sales of the farm-lighting outfits are increasing steadily, and the Georgia distributor for one of the well-known manufacturers reports that his sales of this device during the past three months exceeded the total sales for 1922.

Manufacturers report extraordinarily good sales on the large sizes of outdoor transformer equipment in 500 kw. and over, with the result that deliveries have lengthened to from five to six months. The smaller sizes which ordinarily go into customer substations are still obtainable in from six to sixteen weeks, with inquiries and sales on the increase. The sales of turbo-generators in from 500-kva. to 2,500-kva. capacities have been less than was antici-

Comparative Prices of Station Supplies

	Current Price	Four Weeks Ago	One Year Ago
Soft steel bars, per lb.	$0.0354	$0.0354	$0.0304
Cold finished shafting, per lb.	0.0465	0.0465	0.039
Brass rods, per lb.	0.1475	0.1525	0.17
Solder (half and half), per lb.	0.295	0.295	0.275
Cotton waste, per lb.	.10 to .13	.10 to .13	.09 to .11½
Washers, cast iron (⅛-in.), per 100 lb.	6.50	6.50	6.00
Emery, disks, cloth, No. 1, 6-in. diameter, per 100	3.38	3.38	3.02
Machine oil, per gal.	0.297	0.297	0.33
Belting, leather, medium, off list	30-10%	30-10%	30-10%
Machine bolts, up to 1-in. x 30-in., off list	40-10%	40-10%	40%

pated, but in the larger sizes for central-station installations the orders have exceeded expectations. Long deliveries are the rule on the larger sizes.

New England Collections Reflect Large Volume of Business

A DECIDED improvement in collections is reported by leading jobbers in eastern New England for October, and this month bids fair to maintain the good record lately established. Settlements are not being handed to credit men on a silver platter, to put it mildly, but buyers of electrical material are responding to the interest of sales organizations in the prompt movement of funds, and, in a word, the hard work of the jobbers is bearing good fruit.

Contractor-dealers are finishing a substantial amount of wiring work and are being paid therefor, although there is some complaint around Boston that retail collections are slower than good practice warrants in many instances. Public utilities are prospering and expanding, railroad buying is fairly good, and money is readily obtainable. With the holiday trade close at hand, the outlook is highly favorable for a sound credit situation to continue well through the remainder of the year. Representative houses are cleaning up accounts in from fifty-five to seventy days.

West Coast Business Better; Cautious Rubber-Covered Buying

GENERAL business conditions in California have improved considerably during the last month, and there is little pessimism to be heard in the wholesale and retail trade, where excellent business exists, particularly in radio sets and all household appliances. Iron conduit is moving nicely, but rubber-covered wire is slower as the last unexpected drop of two weeks ago has made the general class of buyers rather cautious.

Some brisk competition in dry cells exists in central California, and among other interesting developments in this field are increased business in waffle irons after an oversold condition of several months, a successful convenience-outlet campaign and increasing industrial activity in switches, receptacle plates, cross-arm braces, glass insulators and the like. Collections are steadily improving and now average fifty days.

The Metal Market

COPPER selling last week displayed a firmer tone than has been witnessed for many months. The red metal was quoted on the New York Metal Exchange for spot delivery at 12.87½ cents, but the larger producing and selling agencies were quoting a firm market at 13 cents a pound, and many were inclined to hold their supplies at 13¼ cents. Present prices represent a gain of approximately ½ cent a pound from the low levels of the year established about ten days ago.

Foreign and domestic copper shipments by North and South American producers in October were the second highest on record during peace time, being approximately 210,000,000 lb., against 160,000,000 lb. in September. The highest shipments of the year were 215,000,000 lb. in March, the peace-time record.

The official contract price for lead by the American Smelting & Refining Company remains at 6.75 cents, New York. This is the price that other producers are also asking and receiving. The market in St. Louis has varied between 6.45 cents and 6.50 cents. One sale at 6.40 cents is reported. Bonded lead for prompt delivery in New York is scarce and commands a premium.

NEW YORK METAL MARKET PRICES

	Nov. 7, 1923 Cents per Pound	Nov. 14, 1923 Cents per Pound
Copper, electrolytic	12.62	12.87½
Lead, Am. S. & R. price	6.75	6.75
Antimony	8.50	9.25
Nickel, ingot	27.00 to 32.00	27.00 to 32.00
Zinc, spot	6.35	6.35
Tin, Straits	42.02	42.05
Aluminum, 98 to 99 per cent.	25.00 to 26.00	26.00 to 27.00

Activities of the Trade

Devoted to News of the
Manufacturer, Jobber, Agent, Contractor and Dealer, Including Important Orders and Contracts for Apparatus and Equipment

Canadian Firm Amalgamates with Babcock & Wilcox

R. O. McCulloch at Toronto announces a deal whereby the Goldie & McCulloch Company, Ltd., Galt, Ont., has amalgamated with the Babcock & Wilcox Company of New York in a new Canadian company to be known as the Babcock, Wilcox, Goldie, McCulloch Company, Ltd. The new concern has secured a charter with a capital stock of $3,000,000 and, according to official announcement, is now operating under the direct management of R. O. McCulloch and A. R. Goldie.

The new company has taken over all of the local business, except part of the steel works—the latter to be operated separately by a different company, to be known for the present as Goldie & McCulloch—and will continue manufacturing operations in its present quarters, although it is announced that a new plant will be erected in Galt for this undertaking in the not distant future.

Reduces Price of Electric Tools

Effective Nov. 12, 1923, a new price of $58 was announced on the Black & Decker Manufacturing Company's half-inch special portable electric drill. One year ago the price of this tool was $85 and on Jan. 1, 1923, the price was reduced to $68. Another reduction is also announced on the Black & Decker electric valve grinder to $34 from $45.

Large Locomotive Order Placed

Twelve electric locomotive and two railroad machine shovels to be operated inside the Moffat tunnel now being pushed through the Continental divide west of Denver have been ordered from the General Electric Company.

It is estimated that the locomotives and shovels will cost in the neighborhood of $40,000. Six of the locomotives ordered will be used in the tunnel at each portal. Other locomotives electrically driven which are to be used for hauling trains through the 6-mile bore have also been ordered from Schenectady, N. Y.

Blaw-Knox Opens Buffalo Office

The Blaw-Knox Company, Pittsburgh, manufacturer of steel transmission towers, has recently opened an office in Buffalo at 622 Genesee Building. J. C. McQuide has been transferred from the Pittsburgh organization to manage the Buffalo office, which now will serve northern and western New York and adjacent territory.

Randle Machinery Officials Organize Radio Firm

Officers identified with the Randle Machinery Company, 1822 Powers Street, Cincinnati, Ohio, rebuilder of power-plant machinery during thirty-seven years, have organized the Randle Radio Company at 1723 Powers Street with a capital stock of $100,000 for the manufacture of radio equipment. It is said that actual production will be started within a week.

Westinghouse's Larger Business

The Westinghouse Electric & Manufacturing Company began the third quarter of its fiscal year auspiciously with incoming orders for October somewhat in excess of the $10,600,000 received in September and with sales billed somewhat ahead of the $13,600,000 of the previous month.

The company has now booked between $100,000,000 and $100,500,000, with five months still to go to reach the $152,328,564 received in the fiscal year ended March 31. Bookings for the next two months are expected to be comparable with those of October.

The net earnings on operations since April 1 exceed those of the 1922 period substantially. Practically all departments continue to operate at capacity, at levels which were only exceeded during the war years.

Burgess Battery Wins Suit

The Burgess Laboratories have been the victors in their fight stretching over a period of years against the French Battery & Carbon Company concerning alleged infringement of patents of the Burgess chromate process. Both concerns are electrical manufacturers in Madison, Wis. Judge E. Ray Stevens of the Circuit Court has ordered the French battery concern to pay the Burgess firm the sum of $46,998 for use of the process during May, 1922, and September of this year.

The French company has been ordered to pay court costs of the case, which amount to approximately $10,000. Owing to the length of the litigation, it is estimated that the suit has cost the French people all of $100,000.

W. N. Matthews & Brother Open New Offices

W. N. Matthews & Brother, Inc., St. Louis, have announced the opening of new offices in Atlanta, Denver, New Orleans and Richmond, Va., in charge of the following men: C. C. Schoen, 138 Marrieta Street, Atlanta; J. A. Lalor, 1633 Tremont Street, Denver; F. J. Commagere, 509 Conti Street, New Orleans, and J. E. Leavy, 317 American National Bank Building, Richmond.

To Sell Hugro Property

Negotiations are in progress for the sale of the plants and property of the Hugro Manufacturing Company, Warsaw, Ind., manufacturer of electric washing machines, a subsidiary of the Dollings Company, bankrupt. Three plants are operated by the company, two being at Warsaw and the third at St. Louis. One of the first noted is conducted under the name of the Laco Manufacturing Company, and the last mentioned by the Remmert Manufacturing Company, another subsidiary. Bert McBride has been appointed the receiver.

New Chicago Battery Plate Maker

The Monarch Battery Plate Manufacturing Company, 215 West Illinois Street, Chicago, has been organized as a partnership by I. Abrams and S. Malina for the purpose of manufacturing lead storage-battery plates. A manufacturing space of 5,000 sq.ft. has been obtained at this location for a production of 10,000 plates per day. Mr. Abrams was formerly secretary and sales manager of the Battery Plate Manufacturing Company of Minneapolis and the Author Storage Battery Company of Chicago.

Lombard Governor Establishes New York City Office

The Lombard Governor Company, Ashland, Mass., manufacturer of waterwheel governors and Diesel-type oil engines, has established a sales office at 30 Church Street, New York City, in charge of W. Merton Rice, formerly with Cox & Stevens. Mr. Rice has had many years' experience in power-plant design and installation, and through the establishment of the New York City office the Lombard Governor Company expects to extend greater sales engineering service to the trade.

Electric Crane & Hoist Changes

H. W. Gledhill, Eastern sales manager of the Shepard Electric Crane & Hoist Company, 30 Church Street, New York City, has opened offices in the City Center Building, 121 North Broad Street, Philadelphia. G. M. Rumsey is connected with the office as assistant sales representative.

The New York office will be managed by A. J. Barnes, who will be in charge of export sales and advertising. H. A. Baugh will have charge of the Pittsburgh office, D. B. Patterson of the Baltimore office, W. B. Briggs of the Chicago office, W. H. Ringe of the San Francisco office and F. R. Quigley of the Birmingham office.

Geier Firm Appoints N. A. Barnell Assistant Sales Manager

Announcement is made of the appointment of N. A. Barnell as assistant sales manager of the P. A. Geier Company, Cleveland, manufacturer of the "Royal" line of electric household appliances. Mr. Barnell is, in point of service, the third oldest member of the Geier sales organization.

Combine G. E. Publication and Advertising Departments

The publication and advertising departments of the General Electric Company will be combined on Dec. 1, with Martin P. Rice, as manager of the publicity department, in charge.

Frank H. Gale, advertising manager, will on Dec. 1 become assistant to D. R. Bullen and manager of conventions and exhibits. Mr. Bullen was recently appointed assistant vice-president, and Mr. Gale will do important association work.

C. H. Lang, who has been assistant to Mr. Rice as manager of the publication department, will continue as assistant manager of the newly created publicity department, and T. J. McManis, who has been manager of the department of publicity for the Edison Lamp Works of the General Electric Company at Harrison, N. J., will also become an assistant manager of the new department.

In addition to the above announcement made by President Gerard Swope, an advertising council has been created, with the following members and with Director B. G. Tremaine, Vice-presidents J. R. Lovejoy, George F. Morrison and F. S. Terry and A. D. Page as ex officio members of this council: Chairman of the council, J. G. Barry; manager of publicity department, M. P. Rice; assistant manager of the publicity department, T. J. McManis; P. B. Zimmerman, George C. Osborne, L. P. Sawyer and G. P. Baldwin; advertising counsel, Bruce Barton, and secretary of the council, C. H. Lang.

"Crescent" Agent for New Jersey

Announcement is made that the Lincoln Products Corporation, 320 Market Street, Newark, N. J., T. P. Cunningham, president, has taken over the sales rights of the "Crescent" electric industrial trucks and tractors for the northern part of New Jersey. Mr. Cunningham and his associates have wide acquaintance in that state and have been selling and installing material-handling equipment for a number of years.

New Agent for Ward Leonard

The Ward Leonard Electric Company, Mount Vernon, N. Y., announces the appointment of W. A. Gibson as its selling representative in the Southwestern territory. Mr. Gibson will make his headquarters in the Roos Building, Elm & Akard Streets, Dallas, Tex., and will handle the complete line of "Vitrohm" resistor units, field rheostats, theater dimmers, motor starters and "Ribohm" rheostats in Dallas and its vicinity.

Frank Adam Electric Business

The Frank Adam Electric Company, 3650 Windsor Place, St. Louis, reports that its business during the past year has been exceptionally good. The volume of business in the month of October was greater than that for any other month in 1923, as well as being the largest single month's business in the last three years. Prospects for future business seem to be bright.

British Manufacturers and Dealers Open Electrical Home

In an effort to establish that £160 will buy more conveniences if expended for electrical equipment in the home than it would if expended in any other way, the British manufacturers and dealers have opened an electrical home in London.

Electric heaters which provide for the British insistence on an open fire are shown in operation. The dining-room equipment includes another appeal to British taste in including an electrically heated dish to keep muffins warm. In addition to fans, washers, irons, vacuum cleaners and the more generally used electrical equipment, the bathroom is equipped with a hot-towel rail, a violet-ray apparatus, a hair drier and a massage device.

Benjamin Window-Trimming Contest to Push Two-Way Plugs

Following the excellent results of an October Hallowe'en window trimming contest, the Benjamin Electric Manufacturing Company, 847 West Jackson Boulevard, Chicago, is now announcing another cash prize contest terminating Thanksgiving week.

All distributors and jobbers are to have a free package of Thanksgiving window-trimming material, and fourteen prizes will be given for the best displayed windows. The first prize totals $100, while the lowest prize is $10. This window-trimming material is used to serve as a background for pushing the sales on the Benjamin two-way plugs.

Kerr Turbine Sales Changes

The Kerr Turbine Company, Wellsville, N. Y., manufacturer of "Economy" turbines and gears, announces several changes and a number of extensions in its sales organization, in which the following new agencies appear: Starkweather & Broadhurst, Inc., 79 Milk Street, Boston; H. R. Hanson, 832 Real Estate Trust Building, Philadelphia; Mechanical Engineering & Equipment Company, 209 South High Street, Columbus; Southern States Equipment Company, 712 Canal-Commercial Building, New Orleans; L. D. Howland, 606 Howard Street, San Francisco, and Henry C. Ashmead, 824 Brown-Marx Building, Birmingham. In addition to the above agencies, the company's representation in Chicago has been increased by the addition of R. N. Turner as salesman.

Manhattan Supply Profits Drop

Net profits of $134,600 after expenses were deducted are shown for the Manhattan Electrical Supply Company, New York City, for the nine months period ended Sept. 30. The income account compares as follows:

	1923	1922
Sales	$5,303,387	$4,923,662
Costs	4,105,464	3,626,794
Gross profit	$1,197,923	$1,296,868
Miscellaneous income	94,091	165,087
Total income	$1,292,014	$1,461,955
Expenses, etc.	1,157,414	1,025,331
Net profit	$134,600	$436,624

Master Electric's Cleveland and Philadelphia Appointments

The appointment of E. R. Locke as Cleveland district manager has just been announced by the Master Electric Company, Dayton, Ohio, manufacturer of single-phase, polyphase and direct-current motors. Mr. Locke was formerly engineer in charge of development work for the General Electric Company in Massachusetts.

Announcement is also made of the appointment of Rodda & Wolfe as managers in the Philadelphia territory. Both Mr. Rodda and Mr. Wolfe are former Westinghouse men, having been associated with the Westinghouse organization for many years in various capacities.

Habirshaw Reorganization Plan Opposed by Creditors

The committee representing the dissenting creditors and bondholders of the Habirshaw Electric Cable Company issued a statement early this week in New York City requesting the other bondholders and creditors to co-operate in opposing the present reorganization plan of that company.

According to the committee, bondholders and creditors representing about $700,000 in claims have expressed opposition to the plan, many of them having already deposited their authorizations with the reorganization committee, and others representing $300,000 are ready to join in a "fair and proper reorganization."

Westinghouse Tennessee Contract

The Tennessee Electric Power Company, which serves the cities of Nashville, Knoxville and Chattanooga, Tenn., and the adjacent territory, has placed with the Westinghouse Electric & Manufacturing Company an order for one 15,000-kva. transformer, one 9,375-kva. transformer, three 2,000-kva. transformers and one 7,500-kva. synchronous condenser.

The company has four hydro-electric stations and two steam auxiliary stations and transmits power over a 120,000-volt line. The transformers have been ordered to take care of additional loads on the system, and the synchronous condenser will be used to improve the power factor at Chattanooga.

New Engineering Firm for St. Louis

Frank H. Schubert, district manager of the Wheeler Condenser & Engineering Company, and William G. Christy, secretary of the St. Louis Section of the American Society of Mechanical Engineers, who until recently has been engineer for the St. Louis Boat & Engineering Company, have announced the organization of the Schubert-Christy Construction & Machinery Company, with offices in the Railway Exchange Building, St. Louis.

This new firm will represent manufacturers of power-plant equipment and will render a general construction engineering service.

The Aladdin Manufacturing Company, Muncie, Ind., manufacturer of electrical appliances for household service, has acquired the local plant of the Highlands Manufacturing Company, manufacturer of kindred specialties, in receivership for about twenty-four months past. The purchasing company has work under way on a new plant unit and will remove the Highlands works to this location as soon as the structure is ready and develop maximum capacity. George N. Spencer is president.

The Stow Manufacturing Company, Inc., Binghamton, N. Y., manufacturer of electric tools, is sending German currency, such as a 100,000-mark note, to each of the users and potential users of its products. Here is the world's worst example of depreciation, and the point is made that the cheap tool in the shop is depreciating like the mark and by inference account should be taken of equipment that might well be renewed.

The Dym Lighting Fixture Company, 624 Grant Street, Pittsburgh, is the name of a new lighting-fixture jobbing house just organized by Jacob Dym, who during eleven years was associated with the Universal Light Company.

The Electro Magnetic Loom Company, New York City, organized with capital stock of $100,000, is said to be perfecting plans for the operation of a plant to manufacture electrically driven loom machines for use in the textile field. The machine, which involves magnetic principles, was invented by Charles G. Bauer of Brooklyn.

The Bart Reflector Corporation, Newark, has acquired about one acre of land at 367 Verona Avenue, Forest Hill district, for the erection of a new one-story plant, 80 ft. x 220 ft., to manufacture indirect-lighting fixtures and equipment.

The F. C. Richmond Machinery Company, Salt Lake City, Utah, representative for the Conveyors Corporation of America, Chicago, has moved offices and salesroom to 320 West Second South Street, Salt Lake City.

The Chicago Pneumatic Tool Company, manufacturer of compressor units, has taken over the exclusive sale of the products of the Crescent Pump Company, 743 Baubien Street, Detroit, and hereafter will handle all inquiries regarding the latter.

H. W. Johns-Manville, Inc., Madison Avenue and Forty-first Street, New York City, is arranging for the early installation of machinery at its plant in course of construction at Asbestos, near St. Johns, Que., comprising two units, 150 ft. x 1,000 ft., for the manufacture of linings, asbestos products, etc., to cost more than $500,000 with equipment. It is purposed to have the works ready for service early next year.

The Newman Electric & Manufacturing Company, Eau Claire, Wis., has been incorporated with $25,000 capital stock to manufacture electrical specialties and to rebuild motors and generators. The new company is the outgrowth of a small business which will soon be enlarged and moved into larger quarters.

L. E. Lewis, formerly manager of the Atlanta office of the Walker Electric & Plumbing Company, is now associated with the Mutual Electric and Machine Company, Detroit. Mr. Lewis will handle the "Bulldog" safety switch line for the Southeastern territory and will be stationed in Atlanta.

Foreign Trade Opportunities

Following are listed opportunities to enter foreign markets. Where the item is numbered, further information can be obtained from the Bureau of Foreign and Domestic Commerce, Washington, by mentioning the number.

Purchase is desired in Antofogasta, Chile (No. 8,088), for electric railway lanterns, dry and storage cell type.

An agency is desired in The Hague, Netherlands (No. 8,085), for radio receiving sets and parts.

Purchase is desired in Basle, Switzerland (No. 8,104), for radio sets, parts and batteries.

The following inquiries have been received by the Philadelphia Commercial Museum, which will furnish names and addresses of inquiries to any desiring them and mentioning the number given: Parties in Guadalajara, Mexico (No. 41,423), would like to get in touch with manufacturers of small rotary electric ovens (such as "Bakerite.") Parties in Wellington, New Zealand (No. 41,451), are interested in hydraulic pipe lines and all things in connection with hydro-electric schemes, and would like to receive from firms manufacturing cement guns catalogs and prices, together with full details regarding capacities, etc. At present they have in mind the lining of a water tunnel about 14,000 ft. in length and about 7 ft. in diameter, as well as other prospective problems. In most cases electric power is available at 400 volts, three-phase, 50 cycles. A party in Rangoon, India (No. 41,456), would like to communicate with manufacturers of boilers, engines, oil engines, electric lamps and electric instruments, etc. Parties in Ponce, Porto Rico (No. 41,460), would like to get in touch with manufacturers of incandescent lamps, table lamps, electric wiring material, etc.

DIVERSION WORK IN CONNECTION WITH ARAPUNI (NEW ZEALAND) POWER SCHEME.—Tenders are being asked, closing early next year, by the Public Works Tender Board, Wellington, New Zealand, for the diversion of the Waikato River in connection with the Arapuni power scheme. The cost of the work is estimated at £500,000.

New Apparatus and Publications

COMMUTATOR STONES.—The Martindale Electric Company, 11-723 Detroit Avenue, Cleveland, is distributing a folder describing its "Imperial" commutator stones and also the "Imperial" commutator grinding tool.

INDUSTRIAL LIGHTING EQUIPMENT.—The Benjamin Electric Manufacturing Company, 847 West Jackson Boulevard, Chicago, has issued bulletin No. 52, covering its industrial lighting equipment. It also contains a series of illustrations showing the results of correct illumination in industrial plants of all types and a demonstration of the more simple calculations for correct industrial illumination.

INCANDESCENT LAMP.—An almost unbreakable lamp is being marketed by the Greater Service Electric Company, 329-331 Broad Street, Newark, N. J. It is an improved mill type, is known as the "Briterlite unbreakable lamp" and is made in 25-watt and 50-watt sizes.

AUTOMATIC COMBUSTION CONTROL.—"Brooke Combustion Control, Electrically Operated," is the title of a leaflet distributed by the Brooke Engineering Company, 411 Perry Building, Philadelphia, covering the "Brooke" automatic combustion control apparatus.

SPINDLE BORER.—The Oliver Machinery Company, Grand Rapids, Mich., has brought out a three-spindle borer, with the motor in the head, designed for the use of woodworkers and furniture workers, etc.

REFRIGERATING SYSTEM.—The Creamery Package Manufacturing Company, 61 West Kinzie Street, Chicago, has placed on the market a refrigerating system, which is to be placed in the cellar near the ice box. It is controlled by a thermostate to maintain the proper temperature.

SAFETY PANEL.—A narrow safety panel, "Naro," in which all parts are removable from the face of the boards and current-carrying parts are protected by a composition covering, has been brought out by the Metropolitan Electric Manufacturing Company, East Avenue and Fourteenth Street, Long Island City, N. Y. A line of shallow wiring devices has also been placed on the market by the company.

SERVICE ELBOW.—An aluminum service elbow, "Gee-Vee," in which the wire can be threaded through the conduit with a straight pull for both conduits, has been developed by the Gillette-Vibber Company, 22 Maple Avenue, New London, Conn.

HORSE-CLIPPING MACHINE.—The Coates Clipper Manufacturing Company, Worcester, Mass., is manufacturing an electrically driven horse and sheep clipper, which is equipped with a suspended or vertical type motor and 8 ft. of Coates "Flex-shaft."

New Incorporations

THE PIKE TOWNSHIP-BRADFORD ELECTRIC COMPANY, Pike Township, Pa., has been incorporated with a capital stock of $5,000 to erect a transmission line in Pike Township. Charles W. Rigg, Pottsville, Pa., is treasurer.

THE LE RAYSVILLE BOROUGH-BRADFORD ELECTRIC COMPANY, Le Raysville, Pa., has been incorporated with a capital stock of $5,000 to erect a transmission line in Le Raysville. Charles W. Rigg, Pottsville, Pa., is treasurer.

THE COUPEVILLE (WASH.) LIGHTING COMPANY has been incorporated with a capital stock of $4,000 by James Zylstra and others.

Construction News

Projects, Plans, Bids and Contracts, Contemplated or Under Way

New England States

BOSTON, MASS.—The Edison Electric Illuminating Company plans to issue $9,083,000 in capital stock, the proceeds to be used for extensions and improvements now in progress and for proposed extensions.

BERLIN, CONN.—Plans are being prepared by the Donnelly Brick Company for the construction of a power house, to cost about $40,000.

NEW BRITAIN, CONN.—Electric power equipment will be installed in the two additions to be erected at the plant of the Stanley Rule & Level Division of the Stanley Works, to cost about $175,000.

WATERBURY, CONN.—The Waterbury Farrel Foundry & Machine Company plans to build an addition to its power house.

Middle Atlantic States

AVON, N. Y.—The Livingston-Niagara Power Company has been granted permission to extend its transmission lines into the town of Conesus to furnish electric service there.

BROOKLYN, N. Y.—The Brooklyn Edison Company is having plans prepared for a substation to be erected on West Twelfth Street, near Neptune Avenue, to cost about $60,000.

CANANDAIGUA, N. Y.—Plans for a municipal electric plant have been abandoned.

GALWAY, N. Y.—The Adirondack Power & Light Corporation, Amsterdam, has been granted a franchise to supply electricity in the town of Galway.

GOUVERNEUR, N. Y.—Bonds to the amount of $100,000 have been voted for the construction of a municipal electric plant.

MOUNT MORRIS, N. Y.—The Mohawk Valley Company, Utica, has acquired the plants of the Mount Morris Illuminating Company and the Mount Morris Water Power Company. Extensions and improvements are planned. Operations will be continued under the present names.

NEW YORK, N. Y.—The New York Edison Company has filed plans for a substation at 37-39 Jane Street, to cost $140,000. William Whitehill, 409 Sixth Avenue, is architect.

OLEAN, N. Y.—The Olean Electric Light & Power Company has been granted permission to erect a transmission line through Little Valley and the towns of Little Valley and Samamanca. The company will not supply electricity in the municipalities named.

ROCKAWAY BEACH, N. Y.—The board of trustees of the Rockaway Beach Hospital plan to build a power house in connection with a mechanical laundry plant, to cost about $42,000. Resler & Hesselbach, 41 East Forty-second Street, New York, are consulting engineers.

SYRACUSE, N. Y.—Plans are being prepared for a new power house at the St. Joseph's Hospital, to cost about $150,000. Goggin & Goggin, University Building, are architects.

WOODSTOCK, N. Y.—The Hudson Electric Corporation has been authorized to extend its electric system into the town of Woodstock.

BOONTON, N. J.—The purchase of the local power plant of the Powerville Paper Mill, to be owned and operated by the municipality is under consideration. If taken over, extensions and improvements will be made.

CHELTENHAM, PA.—The Rowland Shovel Company, Central Avenue, it is reported, will soon call for bids for rebuilding its plant and power house, recently damaged by fire.

DAWSON, PA.—Plans are being considered for rebuilding the power house at the local plant of the Corrado Coal & Coke Company, recently damaged by fire.

DERRY, PA.—The Derry-Dauphin Electric Company is being organized by W. H. Schubert, L. D. West and J. H. Bucher to erect a transmission line in Derry Township. Cooke & Marvin, Harrisburg, are representatives.

MILLERSTOWN, PA.—The Watts Water Power Company and the Juniata Water Power Company, recently organized for joint operations, plan to build a power plant here. S. W. Fleming, J. D. Carpenter and Farley Gannett, all of Harrisburgh, are interested in the companies.

PHILADELPHIA, PA.—The Philadelphia & Reading Railroad Company plans extensions to its power plant in the Port Richmond section, to cost about $500,000.

PHILADELPHIA, PA.—The French Creek Township, Sugar Creek Township and Sandy Creek Township Power corporations have been incorporated, each with a capital stock of $5,000, to erect transmission lines in the respective territories for which they are named. R. Van Horn, 4929 Catherine Street, is treasurer.

PITTSBURGH, PA.—The West Penn-West Virginia Water Power Company, associated with the West Penn Power Company, plans to build a power plant in Wharton Township.

PITTSBURGH, PA.—Plans are being prepared by the Pennsylvania Railroad Company for the electrification of the Allegheny Mountain stretches of its main line. It is proposed to erect power plants at the coal mines to generate electricity to operate the road.

PITTSBURGH, PA.—The Pittsburgh & West Virginia Railway Company, Pittsburgh, it is reported has plans for the construction of a steam-operated power plant at Rook. Crecelius & Phillips, Hanna Building, Cleveland, Ohio, are engineers.

TOWANDA, PA.—The Leraysville Borough-Bradford Electric Company recently incorporated with a capital stock of $5,000, plans to erect a transmission line in Leraysville Borough. Charles W. Riggs, Pottsville, Pa., is treasurer. The same interests have also formed the Pike Township-Bradford Electric Company, with a capital stock of $5,000 to erect a transmission line in Pike Township.

BALTIMORE, MD.—Plans are being considered by the Department of Water for the installation of electrically operated pumping equipment at the Montebello and Mount Royal water stations.

FAIRFIELD, MD.—The United States Industrial Chemical Company, 110 East Forty-second Street, New York City, which is building a plant for the manufacture of commercial potash and kindred products, including power house, to cost about $1,000,000, is preparing plans for the construction of another unit for the production of fertilizer, to cost about $200,000.

WILLIAMSPORT, MD.—The installation of electrically operated pumping machinery in connection with waterworks extensions is being considered by the Council. Norton, Bird & Whitman, Munsey Building, Baltimore, are engineers.

CHARLESTON, W. VA.—The Virginian Power Company is arranging a fund of about $2,000,000 for expansion, including the construction of a hydro-electric plant on Cabin Creek, with initial output of

25,000 kw. and ultimate capacity of 125,000 kw., with transmission system.

GLEN ROGERS, W. VA.—The Raleigh Wyoming Coal Company contemplates rebuilding its power house and mining plant, recently damaged by fire, with loss reported at $300,000.

WARDENSVILLE, W. VA.—The Wardensville Paint & Mineral Company, recently formed, contemplates the installation of electric power equipment at its proposed local plant.

WHEELING, W. VA.—The West Virginia Match Company plans to install electric power equipment at its proposed plant at McColloch and Thirty-sixth Streets. F. F. Harris, 1117 Chapline Street, is architect.

HAMPTON ROADS, VA.—Bids will be received by the Bureau of Supplies and Accounts, Navy Department, Washington, D. C., until Nov. 27, for three electric motors for the local navy yard. (Schedule 1548.)

LYNCHBURG, VA. — The Consolidated Power & Light Company has issued $1,500,000 in capital stock, part of the proceeds to be used for extensions and improvements.

NORFOLK, VA.—The Ford Motor Company, Detroit, plans to build a power house at its proposed local assembling plant in the Newton Park section, to cost about $400,000.

SALEM, VA.—Steps have been taken to install a new ornamental lighting system on Main Street to cost about $4,000.

WASHINGTON, D. C.—Bids will be received by the Bureau of Supplies and Accounts, Navy Department, until Nov. 20, for 50,000 ft. antenna wire (Schedule 1546); also, until Nov. 27, for four electric ovens and spare parts for Eastern and Western yards. (Schedule 1547.)

North Central States

HUDSON, MICH.—The Southern Michigan Light & Power Company, it is reported, has entered into an agreement with the Hudson & Citizens' Light & Power Company for furnishing service at Hudson, North Adams, Addison, Manitou, Prattville and vicinity, heretofore supplied by the Hudson company. A transmission line will be erected from Adrian to Hudson by the Southern Michigan company. The Hudson company will build a similar line to Morenci.

KALAMAZOO, MICH.—The Valley Paper Company, Press Building, contemplates building a power house at its proposed local paper mill, to cost about $450,000. Billingham & Cob, Press Building, are architects.

CLEVELAND, OHIO. — The Cleveland Railway Company plans to erect two substations, one at West Sixty-fifth Street and Lorain Avenue and the other at West Twenty-ninth and Church Streets, each to cost about $35,000.

LORAIN, OHIO.—The Ohio Public Service Company has made an agreement with the City Council for the erection of a transmission line on certain streets, which will extend beyond the city limits for service in this section.

TOLEDO, OHIO.—The Toledo Edison Company contemplates extensions and improvements, to cost about $473,000.

YOUNGSTOWN, OHIO.—The Ohio River Edison Company is negotiating for right-of-way for its proposed transmission line from Toronto to this district, a distance of 39 miles. The project includes the construction of a power house at Toronto with an initial output of 88,000 hp., a 39-mile transmission line and substations.

BOWLING GREEN, KY.—Arrangements have been made by the Kentucky-Tennessee Light & Power Company for the erection of a 33,000-volt, three-phase, 60-cycle transmission line from Bowling Green to Asphalt and Brownsville, a distance of 26 miles. The cost is estimated at $72,000. O. E. Wessel, Bowling Green, is assistant general manager.

BOWLING GREEN, KY.—The franchises and properties of the Kentucky & Tennessee Light & Power Company, operating at Pembroke, Guthrie, Trenton, Elkton and Allensville, Ky., and Adams, Tenn., have been acquired by the Kentucky Public Service Company, Bowling Green, which will change the name to the Kentucky-Tennessee Light & Power Company, with main office at Bowling Green.

LOUISVILLE, KY.—The Louisville Gas & Electric Company contemplates building a garage and repair shop at Seventh and Ormsby Avenues, to cost about $40,000.

FARMERSBURG, IND.—Plans are under way for the installation of electrically operated pumping equipment at the proposed municipal waterworks, to cost about $40,000.

INDIANAPOLIS, IND.—The Indianapolis Light & Heat Company has preliminary plans for the construction of a new plant on the White River, about 8 miles from the city, to cost about $1,000,000.

CHICAGO, ILL.—Bids will be received by Harry E. Wallace, clerk, Room 700, 910 South Michigan Avenue, Chicago, until Nov. 22, for construction of the Calumet intercepting sewer as follows: Division A—sewers; Division B—pumping station substructure; Division C—pumping station superstructure; Division D—pumps, consisting of three 72-in. centrifugal pumps and three 30-in. centrifugal pumps with accessories; Division E—electrical equipment, consisting of three 500-hp. synchronous motors, three 75-hp. synchronous motors, six 667-kva. transformers, six 75-kva. transformers, two 75-kva. motor-generator sets, and miscellaneous electrical equipment; Division F—switchboard, conduit and wiring; Division G—erection of general equipment and furnishing and erecting miscellaneous equipment.

GALESBURG, ILL.—The Illinois Power & Light Company is planning to erect a double-circuit, 66,000-volt transmission line from its power plant at Keokuk, Iowa, to Galesburg, a distance of 60 miles. An extension of the line carrying 33,000 volts, will be erected from Galesburg to Galva, 23 miles. The cost is estimated at $1,250,000.

BIRON, WIS.—The Consolidated Water Power & Paper Company is planning to build a boiler house, to cost about $40,000.

COLBY, WIS.—The Wisconsin-Minnesota Light & Power Company, Eau Claire, contemplates erecting a local substation, to cost about $20,000.

OSHKOSH, WIS.—Plans are under consideration to extend the ornamental lighting system on Jackson Drive from Michigan Street north to the city limits, and also to extend the ornamental lamps on Washington and Algoma Boulevards.

SHEBOYGAN, WIS.—A petition has been presented by the Business Men's Association to the City Council asking for the installation of an ornamental lighting system on Pennsylvania Avenue.

STEVENS POINT, WIS.—The property of the Springville Roller Mill Company, including water rights on the Plover River, has been purchased by E. A. Oberweiser, Stevens Point. The new owner is considering increasing the output of the electric plant.

STURGEON BAY, WIS.—Arrangements have been made by the Fruit & Dairy Box Company for doubling the output of its power house, to include new boiler and other equipment.

LITTLE FALLS, MINN.—The installation of electrically operated pumping machinery at the proposed municipal waterworks, to cost about $100,000, is under consideration. The Claussen & Carroll Engineering Company, Metropolitan Bank Building, St. Paul, is engineer.

RED WING, MINN.—The Wisconsin-Minnesota Light & Power Company, Eau Claire, plans to build a substation in Red Wing, to cost about $40,000.

ROCHESTER, MINN. — Electric power equipment will be installed in the proposed local ice and cold-storage plant to be erected by Matthew Fitzpatrick and associates, to cost about $250,000.

SPRING VALLEY, MINN.—The Northwest Utilities Company has arranged for an increase in capital stock from $1,000,000 to $45,000,000, part of the proceeds to be used for extensions and improvements.

CLERMONT, IOWA.—The Northeastern Iowa Power Company plans to erect a transmission line from Volga City to Elkader to supply electricity to the Elkader Light & Power Company. The latter company furnishes electricity in Elkader and several other towns in this vicinity.

OTTUMWA, IOWA.—The Ottumwa Ice Company plans to rebuild its power house recently damaged by fire.

ROCKWELL, IOWA.—The Iowa Light, Heat & Power Company plans to rebuild its local plant, recently destroyed by fire, at once. About twenty other towns were supplied through this plant.

WYOMING, IOWA.—Bonds to the amount of $35,000 have been voted for to establish a municipal electric plant.

UTICA, S. D.—The Eastern Dakota Electric Company plans to erect a transmission line from Yankton to Utica for local service.

WALTHILL, NEB.—Bonds to the amount of $20,000 have been authorized to install a municipal electric light plant.

Southern States

DURHAM, N. C.—The development of a water-power project on the Flat River, to cost about $2,000,000, is reported to be under consideration by R. W. Rigsby, city manager.

MEBRANE, N. C.—The White Furniture Company has preliminary plans for the construction of a steam-operated power plant. Later on it is proposed to equip the furniture factory throughout for electrical operation.

MURPHY, N. C.—Application has been made to the Federal Power Commission by the Southern Appalachian Power Company for authority to build a hydro-electric project on the Hiawasee River in Cherokee and Clay Counties to develop 50,000 hp. W. N. Garrett, Asheville, is president.

MACON, GA.—Surveys are being made by the Macon Railway & Light Company in connection with the construction of a proposed hydro-electric plant, to develop about 13,000 hp. The proposed plant will provide power for industrial operation in the middle Georgia territory and will cost from $1,500,000 to $2,000,000.

RINGGOLD, GA.—Plans to establish a municipal electric light and water plant are under consideration.

SAVANNAH, GA.—Bids will be received by the Supervising Architect, Treasury Department, Washington, D. C., until Nov. 28, for lighting fixtures for the local marine hospital.

STONE MOUNTAIN, GA.—Plans are under consideration to establish an electric plant in connection with a resort here. Alonzo Atkins, Birmingham, Ala., and others are interested in the project.

AVON PARK, FLA.—Steps are being taken for extensions in the ornamental street-lighting system.

KELSEY CITY, FLA.—Plans for the proposed plant of the American Fibre Corporation, recently organized, provide for a power house. The cost of the project is estimated at $150,000.

CHATTANOOGA, TENN. — Plans are being considered for the installation of an ornamental lighting system on Main Street, from Whiteside to Wilhoit Street, to cost about $19,000.

COPPERHILL, TENN.—The construction of a hydro-electric development on the Ocoee River, 6 miles below Copperhill, to develop 15,000 hp., is under consideration by the Tennessee Electric Power Company, Chattanooga.

HARTFORD, TENN.—A hydro-electric development on the Pigeon River is reported to be under consideration by Mr. Boice, president of the Boice Hardwood Company.

LAUREL, MISS.—The Continental Turpentine & Rosin Company plans to rebuild its power house, recently damaged by fire.

RIPLEY, MISS.—Extensions are contemplated to the local electric plant, to cost about $10,000. Bennett & Gurney are engineers in charge. A. C. Anderson is president.

FORT SMITH, ARK.—The Fort Smith Light & Traction Company contemplates extensions and improvements, including the installation of additional equipment, to cost about $100,000.

HEBER SPRINGS, ARK. — Permission has been granted to the Arkansas Light & Power Corporation, Pine Bluffs, to construct a power dam across the Little Red River, in Clebourne County.

GRAYSON, LA.—Plans are under consideration for the installation of a street-lighting system.

OKLAHOMA CITY, OKLA.—Bids will be received at the office of the Supervising Architect, Treasury Department, Washington, D. C., until Dec. 7, for the installation of a new deep-well pump, etc., in the United States Post Office, Oklahoma City. For details see Searchlight Section.

PURCELL, OKLA.—The Atchison, Topeka & Santa Fé Railway Company plans extensions to its local power house, to cost about $20,000.

ELGIN, TEX.—K. H. Smith, Austin, Tex., plans to construct and operate a local electric and ice plant to cost about $50,000.

HOUSTON, TEX.—The Houston Lighting & Power Company contemplates improvements to the Gabel Street, to cost about $60,000.

MOUNT PLEASANT, TEX.—The Texas Public Service Company plans to erect a 33,000-volt transmission line to Winfield.

NAVASOTA, TEX.—Extensions and improvements, to cost about $40,000, are under consideration by the Western Public Service Company. The work will include the installation of boilers, new ice-making machine and additional ice-storage facilities.

Pacific and Mountain States

LYMAN, WASH.—Application has been filed by E. Clarence Miller of the Miller Engineering Company, Seattle, for permission to utilize water from the South Fork of the Nooksack River in connection with a hydro-electric project near Lyman, to cost about $1,500,000. Plans provide for a dam on Jones Creek to develop 11,340 hp. The proposed plant will serve Lyman, Hamilton, Concrete, Sedro Woolley, Burlington, Mount Vernon and other towns in Skagit County.

WENATCHEE, WASH.—Plans are being prepared for the installation of a lighting system on South Wenatchee Avenue.

WENATCHEE, WASH. — The Puget Sound Power & Light Company, Seattle, has been granted a permit to erect a substation here, to cost about $120,000. The station will receive power from the White River plant of the company.

WESTPORT, WASH.—Bids will soon be asked by the Superintendent of Light Houses, Portland, Ore., for the construction of a reinforced-concrete power house at Gray's Harbor Light Station, Westport.

WOODLAND, WASH.—The North Coast Power Company plans to install a three-phase system to replace the present system. The cost is estimated at $10,000.

BELDEN, CAL.—The Great Western Power Company, San Francisco, plans erection of a transmission line to the Canyon dam.

GLENDALE, CAL.—Plans are being prepared for an ornamental lighting system on Colorado Street. B. F. Dupuy is city engineer.

LOS ANGELES, CAL.—An ordinance has been passed authorizing the installation of a lighting system on Jefferson Street.

SACRAMENTO, CAL.—Bids will be received at the office of the supervising architect, Treasury Department, Washington, D. C., until Dec. 6 for a new lighting system, etc., in the United States post office and court house, Sacramento. For details see Searchlight Section.

SAN FRANCISCO, CAL.—The Mount Shasta Power Corporation has applied to the State Water Department for permission to construct a power house on Rock Creek, to cost about $75,000.

TUBBS ISLAND, CAL.—The Pacific Gas & Electric Company, San Francisco, plans to erect a transmission line here for commercial service, to cost about $60,500.

BOULDER, COL.—Steps have been taken by the Retail Merchants' Association for the installation of an ornamental lighting system in the business section. The plans call for 224 lamp standards, to cost about $27,000.

Canada

HALIFAX, N. S.—The Albany Perforated Wrapping Paper Company, Albany, N. Y., will build a substation at its proposed pulp mill at Sheet Harbor, near Halifax, to cost about $300,000. Electricity will be secured from the Nova Scotia Power Commission.

CHELTENHAM, ONT.—A bylaw has been approved by the ratepayers of the township of Chinguacousy granting a franchise to the Cataract Electric Company, Ltd., to supply electricity in the township.

TORONTO, ONT.—Plans are being prepared by the Hydro-Electric Power Commission of Ontario for two auxiliary steam-driven plants, one to be erected in the London district and the other probably at Windsor.

WIARTON, ONT.—The Council has requested the Hydro-Electric Power Commission of Ontario to submit estimates of the cost of developing electric power from the Sauble River.

LEVIS, QUE.—The construction of a hydro-electric plant on Megiscan River, near Temiscamingue, to develop 22,000 hp., is reported to be under consideration by L. N. Hart, Commercial Street, Levis.

QUEBEC, QUE.—Work, it is reported, has started on the plant of the Laurentian Hydro-Electric Company. The company has secured exclusive franchises to furnish electricity in St. Jerome, Shawbridge, Ste. Adele, Val Morin, Ste. Marguerite, Lac Masson and Val David.

Electrical Patents

Announced by U. S. Patent Office

(Issued Oct. 23, 1923)

1,471,913. ELECTRIC HEATER; A. N. Otis, Schenectady, N. Y. App. filed April 2, 1921. Electric resistance heaters for steam boilers.

1,471,922. INDIRECT LIGHTING; P. Ross, Liverpool, England. App. filed Aug. 21, 1922. Series of adjustable deflector reflecting surfaces provided.

1,471,957. ELECTRIC POWER DEVICE; W. C. Hahne, Elgin, Ill. App. filed April 14, 1922. Mechanical rectifier.

1,471,976. SPARK-PLUG TESTER; W. P. Moore, Worland, Wyo. App. filed March 27, 1922.

1,472,001. SYSTEM AND APPARATUS FOR MOTOR CONTROL; J. A. Hepperlen, East Orange, N. J. App. filed Feb. 13, 1923. Controlling speed of motor by electromagnetic switch.

1,472,023. COMMUTATOR FOR DYNAMO-ELECTRIC MACHINES; L. E. Koos, Toledo, Ohio. App. filed July 22, 1918. Method of making commutator bars.

(Issued Oct. 30, 1923)

15,706 (reissue). TWO-WIRE PARTY LINE LOCKOUT TELEPHONE SYSTEM; T. G. Martin, Chicago, Ill. App. for reissue filed Dec. 7, 1921.

15,710 (reissue). ELECTRIC STEAM AND HOT-WATER BOILER; N. R. Forssblad, Vasteras, Sweden. App. for reissue filed Aug. 29, 1922. Control of output effected by raising or lowering insulating tubes surrounding electrodes.

1,472,035. MEANS FOR SIGNALING OVER MULTIPLEX TRANSMISSION CHANNELS; H. A. Affel, Brooklyn, N. Y. App. filed July 29, 1919. Utilizes carrier-current frequencies.

1,472,052. ELECTROSTEAM RADIATOR; F. M. Davis, Chicago, Ill. App. filed April 17, 1922. Combined with regular steam-heating system.

1,472,092. RECEIVER FOR WIRELESS TELEGRAPHY; H. J. Round, London, England. App. filed July 9, 1921. Method of reducing static.

1,472,124. AIR-HEATING ATTACHMENT FOR FANS; F. M. Howe, New York, and C. Naegeli, Long Island City, N. Y. App. filed Dec. 21, 1921. Combined fan and electric heater.

1,472,125. MEASURING APPARATUS; E. A. Keeler, Norristown, Pa. App. filed Oct. 19, 1920. Galvanometer controlled in response to changes in conductivity of a solution.

1,472,137 to 1,472,139. ELECTRIC FURNACE; T. A. Reid, Wilkinsburg, Pa. App. filed Nov. 2, 1921. Resistance type.

1,472,143. CAR-HEATING SYSTEM; K. A. Simmon, Edgewood Park, Pa. App. filed May 11, 1921. Automatically according to temperature of car and load drawn by motors.

1,472,151. BRAKE; E. M. Bouton, Wilkinsburg, and R. Pruger, Pittsburgh, Pa. App. filed May 15, 1919. Electromagnetic brake for hoisting apparatus.

1,472,154. BUSBAR SUPPORTING STRUCTURE; J. M. Brown, Pittsburgh, Pa. App. filed Dec. 31, 1918. Automatically compensates for expansion forces.

1,472,161. SYSTEM OF CONTROL; C. Le G. Fortescue, Pittsburgh, and L. J. Hibbard, Wilkinsburg, Pa. App. filed May 14, 1921. Method of accelerating railway motors.

1,472,169. ELECTROLYTE FOR ELECTROLYTIC CONDENSERS; E. J. Haverstick, Oakmont, Pa. App. filed March 23, 1921. Solution of sodium aluminate, tri-sodium phosphate and sodium fluoride.

1,472,170. ELECTRICALLY HEATED SOLDER POT; J. D. Haynsworth, Mansfield, Ohio. App. filed March 30, 1921. Method of manufacture.

1,472,171. ELECTRIC HEATER; J. D. Haynsworth, Mansfield, Ohio. App. filed May 14, 1921. For use in rooms containing explosive or inflammable material.

1,472,172. SINGLE-PHASE COMMUTATOR MOTOR; R. E. Hellmund, Swissvale, Pa. App. filed Jan. 26, 1917. Railway motor.

1,472,183. SOLDERING IRON; A. M. MacFarland Wilkinsburg, Pa. App. filed Aug. 18, 1921. Removable heat cartridge.

1,472,184. SWITCHING DEVICE; J. B. MacNeill, Wilkinsburg, Pa. App filed Feb. 4, 1918. For controlling electrically operated circuit interrupters.

1,472,185. VULCANIZING APPARATUS; E. A. Mollenhauser, Spokane, Wash. App. filed Oct. 20, 1921. Electric current imports its heat directly to material.

1,472,186. DIRECTION INDICATOR FOR MOTOR VEHICLES; C. E. Morris, Grimes, Cal. App. filed May 8, 1920. Rear direction signal.

1,472,197. ELECTRIC WATER HEATER; E. E. Sutherland, Mansfield, Ohio. App. filed Oct. 25, 1921. Immersion heater of relatively large size.

1,472,198. ELECTRICAL MEASURING INSTRUMENT; H. B. Taylor, Wilkinsburg, Pa. App. filed Nov. 16, 1917. Galvanometer of unipivot type.

1,472,201. ELECTRICAL HEATER FOR COFFEE URNS; J. C. Woodson, Mansfield, Ohio. App. filed Oct. 20, 1921.

1,472,215. ELECTRODE HOLDER; G. Goughnour, Canton, Ohio. App. filed June 7, 1920. For varying sizes of furnace electrodes.

1,472,218. TRANSMISSION AND RECEIVING SYSTEM; J. H. Hammond, Jr., Gloucester, Mass. App. filed Aug. 5, 1919. Two secondary frequencies used for transmitting radio signals.

1,472,233. VAPORIZER FOR INTERNAL-COMBUSTION ENGINES; A. J. Taylor, Jr., and C. E. Harper, Jr., Chicago, Ill. App. filed Dec. 15, 1921.

1,472,237. TELEPHONE TRANSMISSION SYSTEM; W. H. Bendernagel, Queens, N. Y. App. filed Dec. 6, 1919. Amplifying repeater in subscriber's circuit.

1,472,246. THROTTLE HEATER; P. Daniel, Boundbrook, N. J. App. filed Aug. 26, 1920. Automobile manifold heater.

1,472,254. TELEPHONE SYSTEM; C. Spraks, Chicago, Ill. App. filed May 15, 1916. Multiple-line lamp systems.

1,472,257. SERVO-MOTOR FOR AEROPLANES; M. M. Titterington, Brooklyn, N. Y. App. filed Nov. 9, 1917. Remote control for guiding aircraft.

1,472,281. METHOD OF AND APPARATUS FOR HYDROGENATING UNSATURATED COMPOUNDS; C. M. Page, Chicago, Ill. App. filed Feb. 24, 1921. Constant and automatic regeneration of catalytic agent electrically.

1,472,289. RADIO-WIRE CONNECTING CIRCUITS; R. Brown and E. L. Nelson, East Orange, N. J. App. filed April 26, 1921. Link circuits for establishing connections between wire lines and radio systems.

1,472,335. MAGNETO FLASHLIGHT; A. Luzy, Paris, France. App. filed May 1, 1922. Self-contained spring-driven generator.

1,472,341. REED TELEPHONE RECEIVING; G. W. Pickard, Newton Center, Mass. App. filed Nov. 19, 1920. For radio or wire communication.

1,472,351. AUTOMATIC SWITCH FOR INTERCONNECTING LINES; F. Aldendorff, Wilmersdorf, Berlin, Germany. App. filed Nov. 28, 1913. Quick-acting line finders for automatic telephone systems.

1,472,359. MANUFACTURE OF DRY-BATTERY CANS; W. H. Finkeldey and W. McG. Peirce, Palmerton, Pa. App. filed Jan. 12, 1922.

1,472,391. TERMINAL SEAL FOR STORAGE BATTERIES; B. Ford, Philadelphia, Pa. App. filed June 15, 1920. Wedge means arranged between post and cover.

1,472,451. PHANTOMED SIGNALING CIRCUITS; M. K. Akers, East Orange, N. J. App. filed Sept. 3, 1920. Telephone lines capable of being phantomed.

1,472,453. PRINTING TELEGRAPHY; J. H. Bell, South Orange, N. J. App. filed Jan. 20, 1920. Characters are printed in continuous line.

1,472,458. NUMBER-INDICATING SYSTEM; E. H. Clark, Richmond Hill, N. Y. App. filed Dec. 26, 1919. For use in automatic telephone exchange systems.

1,472,460. TELEPHONE SYSTEM; H. P. Clausen, Mount Vernon, and C. L. Goodrum, New York, N. Y. App. filed Dec. 28, 1918. Arrangement for controlling automatic switches over long-distance trunks.

1,472,463. TELEGRAPH REPEATING SYSTEM; A. J. Eaves, New York, N. Y. App. filed April 30, 1921. Operated according to half-duplex method.

1,472,469. TELEPHONE-EXCHANGE SYSTEM; C. L. Goodrum, New York, N. Y. App. filed Nov. 26, 1920. Machine-switching apparatus.

1,472,470. METHOD OF AND MEANS FOR PRODUCING ALTERATING CURRENTS; R. V. L. Hartley, Brooklyn, N. Y. App. filed March 30, 1918. Vacuum-tube discharge type.

1,472,477. ELECTRON DISCHARGE DEVICE; R. W. King, New York, N. Y. App. filed Aug. 14, 1919. Audion type for high voltages and large operating currents.

1,472,483. TELEGRAPH SYSTEM; R. C. Mathes, New York, N. Y. App. filed Oct. 21, 1919. Method of winding and connecting ratio arms of duplex network.

1,472,485. TELEPHONE SYSTEM; J. S. Morrill, St. Louis, Mo. App. filed Dec. 11, 1920. Loaded lines for system with several substations.

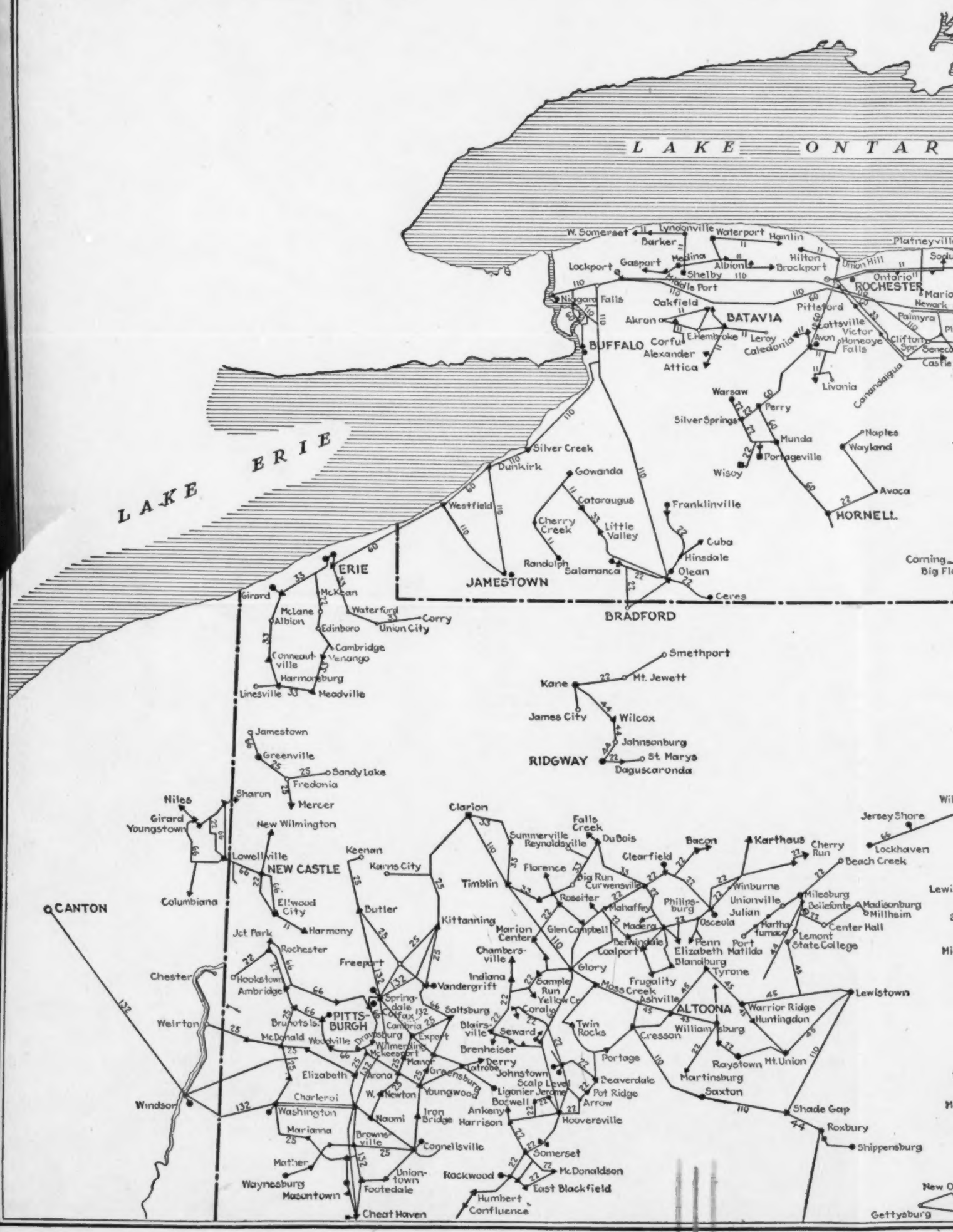
1,472,501. MACHINE-SWITCHING TELEPHONE-EXCHANGE SYSTEM; R. L. Stokely, Floral Park, N. Y. App. filed Dec. 8, 1920. Improved circuit arrangement to take care of toll calls.

Interconnected Lines and Statio

Transmissio

Figure

Central Station Generator Rating and Output 1922			
State	A. C. Rating Kva.	D. C. Rating Kva.	Kw.-hr. Generated
New Hampshire	75,000	3,793	94,712,707
Vermont	121,550	1,785	206,513,228
Massachusetts	900,300	14,061	1,501,488,253
Rhode Island	212,475	2,950	341,592,302
Connecticut	253,152	5,290	543,521,094
New York	1,973,825	11,292	4684,210,464
New Jersey	346,966	1,501	1,061,086,418
Pennsylvania	1,528,483	24,532	4,253,497,276



Supplement to ELECTRICAL WORLD, November 17, 1923

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According to Data Collected by

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Figures on Transmission Lines Give the Voltage Expressed in Kilovolts

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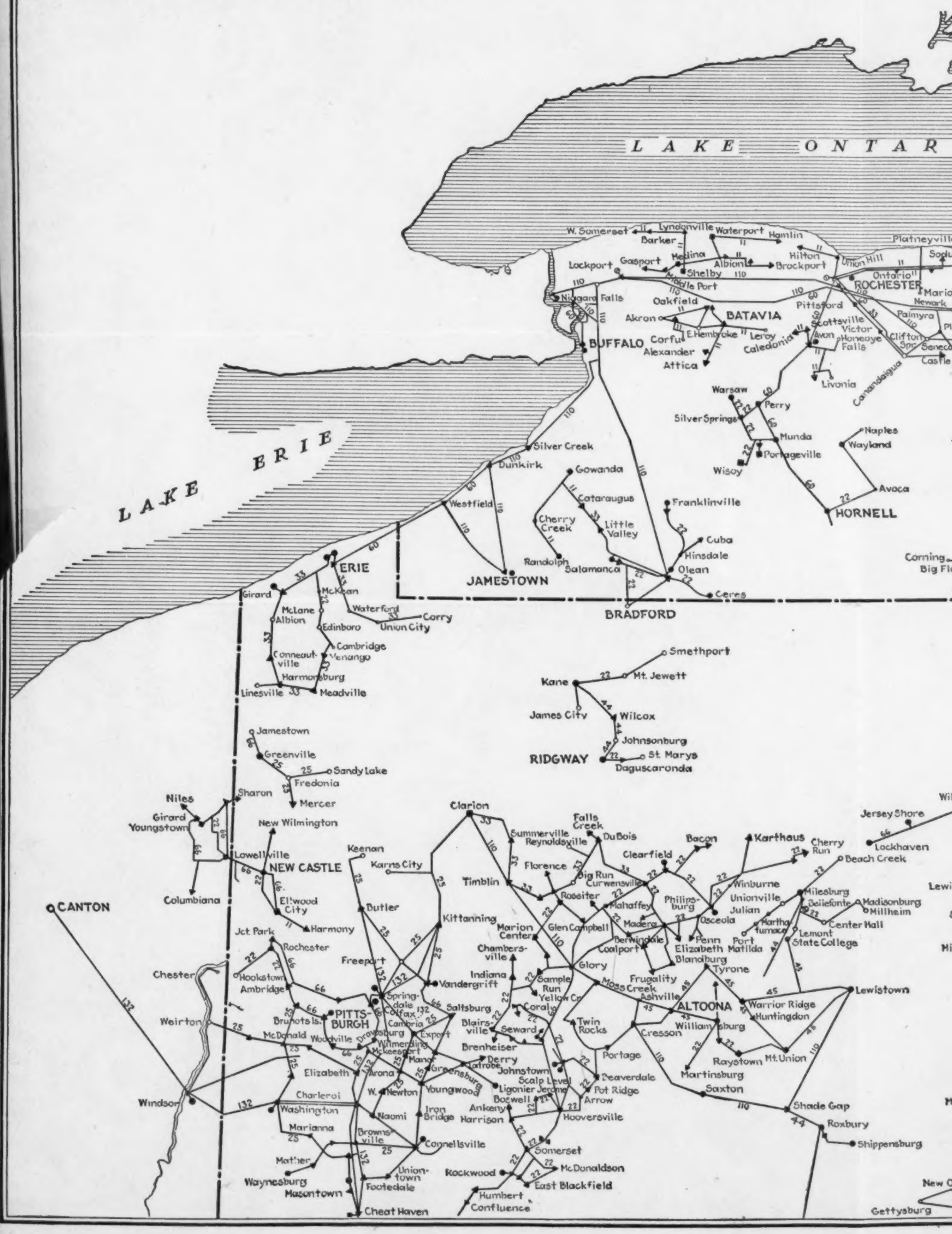

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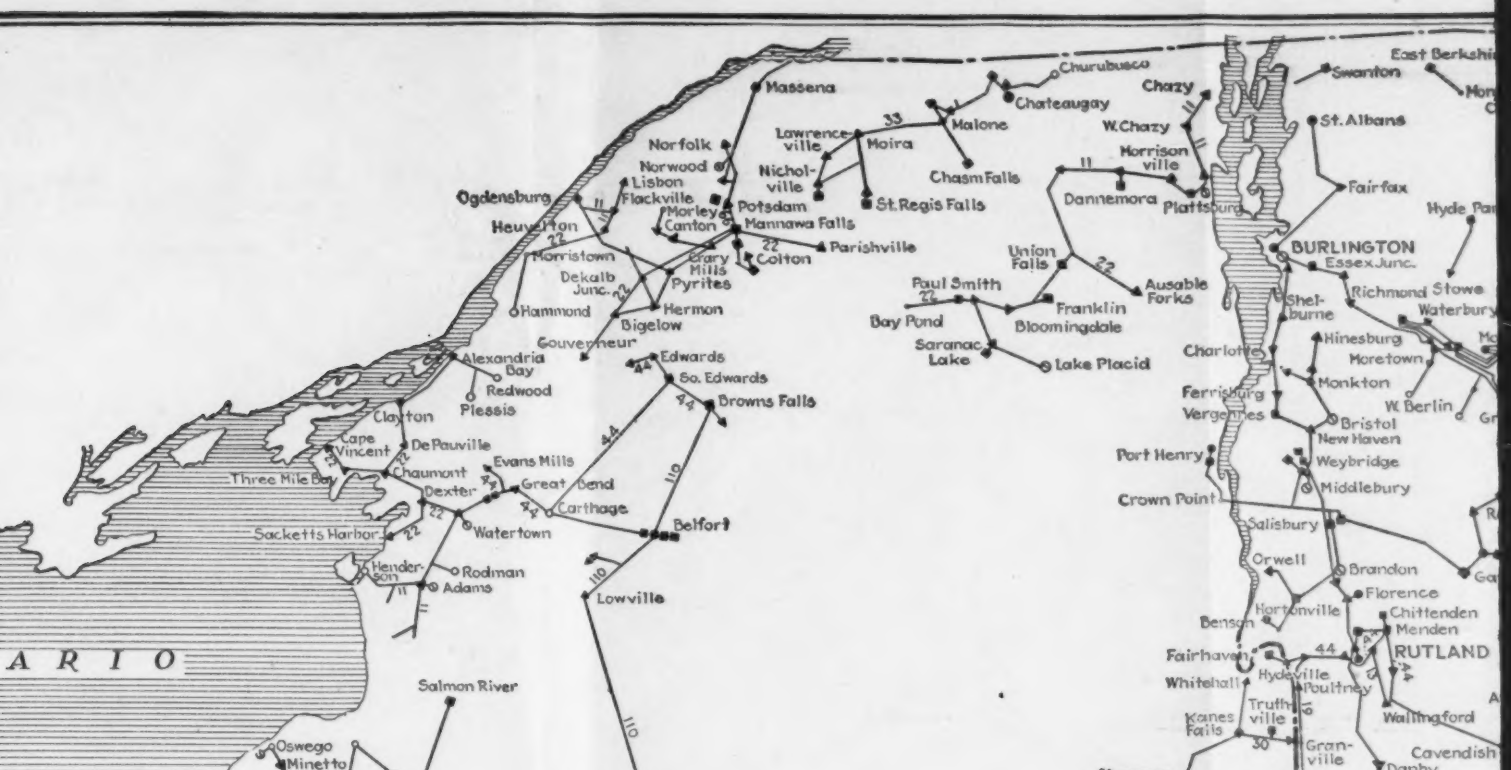
Massena
Churubusco
Chateaugay
Chazy
Swanton
East Berkshi
Norfolk
Norwood
Lisbon
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Lawrence-ville
Moira
Malone
W. Chazy
St. Albans
Nichol-ville
Chasm Falls
Morrison-ville
Ogdensburg
Heuvelton
Morley
Canton
Potsdam
Mannawa Falls
St. Regis Falls
Dannemora
Plattsburg
Fairfax
Hyde Par
Morristown
Dekalb Junc.
Gary Mills
Pyrites
Parishville
Colton
Union Falls
Ausable Forks
BURLINGTON
Essex Junc.
Richmond
Stowe
Paul Smith
Bay Pond
Saranac Lake
Franklin
Bloomingdale
Lake Placid
Hammond
Hermon
Bigelow
Gouverneur
Edwards
So. Edwards
Alexandria Bay
Redwood
Plessis
Browns Falls
Clayton
Cape Vincent
De Pauville
Chaumont
Three Mile Bay
Dexter
Evans Mills
Great Bend
Carthage
Belfort
Sacketts Harbor
Watertown
Hender-son
Rodman
Adams
Lowville
Shel-burne
Waterbury
Hinesburg
Moretown
Charlotte
Monkton
Ferrisburg
Vergennes
W. Berlin
Bristol
New Haven
Port Henry
Weybridge
Middlebury
Crown Point
Salisbury
Orwell
Brandon
Florence
Hortonville
Benson
Chittenden
Menden
Fairhaven
Whitehall
Hydeville
Poultney
RUTLAND
Wallingford
Kanes Falls
Truth-ville
Gran-ville
Cavendish
Danby
Manchester
Sherman Island
Glens Falls
Feeder Dam
Rupent
Spier Falls
Fort Edward
Saratoga Spr.
Northville
Broadalbin
Mayfield
Sprite Creek
Inghams Mills
Cloversville
Johnstown
Ballston Spa
Newtown
Johnson-ville
Mechanicville
Somerset
Searsburg
Benning-ton
Pittsfield
Lee
Salmon River
Oswego
Minetto
Parish
Fulton
Phoenix
Platteyville
Sodus
Red Creek
Wolcott
Holland Patent
Trenton Falls
Rome
Newport
Oneida
UTICA
Dolgeville
Clarks Hills
Frankfort
Mohawk
Canastota
Clinton
Sauquoit
Little Falls
Ephratah
Fort Plain
Canajoharie
Rotterdam
Oriskany Falls
Henderson
Bridgewater
Richfield Spr.
Hamilton
Schuyler Lake
Sharon Spr.
SCHENECTADY
Waterylie
TROY
ALBANY
Ravena
Cohoes
Watkins
Millport
Whitney Point
Bainbridge
Sydney
Norwich
Oneonta
Colliers
Gilboa
Stamford
Coxsackie
Cairo
Chatham
Stuyvesant Falls
Philmont
Hunter
Tannersville
CATSKILL
Hudson
Copake Falls
Hillsdale
Westfield
Pittsfield
Lee
Walton
Maine
Endicott
Union
Binghamton
Johnson City
Deposit
Corning
Big Flats
ELMIRA
Chemung
Wellsburg
Oswego
Apalachin
Nichols
Sayre
Hancock
Shandakin
Saugerties
Rhinebeck
KINGSTON
Eddyville
Canaan
Falls Village
Winstead
Tariffville
Thompsonv
Millerton
Simsbury
Torrington
Unionville
Liberty
High Falls
Monk Falls
Ellen-ville
Rifton
Millbrook
Washington Hollow
POUGH-KEEPSIE
Bantam
Bulls Bridge
Thomaston
Waterbury
Bris-
Monticello
Summitville
Mongaup Falls
Wurtsboro
Walden
Dahm-ville
Pawling
Beacon
NEWBURGH
New Milford
Woodbury
Brookfield
Danbury
Cheshire
Naugatuck
Beacon Falls
NEW HA
Stevenson
Seymour
Devon
Derb
Cuddeback-ville
Middletown
Goshen
Highland Falls
Port Jervis
Monroe
Harriman
Warwick
Tuxedo
Peekskill
Haverstraw
Millburn
Nyack
Sussex
Suffern
Ramsey
Orangeburg
Ridge-wood
Norwalk
Cos Cob
STAMFORD
Riverhead
Mansfield
Dalton
SCRANTON
Kingston
Pittston
Plymouth
WILKESBARRE
Williamsport
Milton
Lewisburg
Danville
Berwick
Bloomsburg
St. Johns
Freeland
Harwood
Hauto
Mauch Chunk
Sunbury
Shamokin
Mt. Carmel
Shenan-doah
Mahanoy City
Tamaqua
Frackville
Middle Creek
Minersville
Pottsville
Port Clinton
Hamburg
Pine Grove
Catasauqua
ALLENTOWN
Siegfried
Easton
Stroudsburg
Delaware Water Gap
Columbia
Penargy
Newton
Hibernia
Netcong
Dover
Boonton
Passaic
Rutherford
Florham Park
Paterson
Englewood
Hacken-sack
Mt. Vernon
NEWARK
JERSEY CITY
Bernards-ville
Elizabeth
Roselle
Crawford
Rahway
Plainfield
Somerville
Boundbrook
New Brunswick
Metuchen
Perth Amboy
So. Amboy
Keyport
Middletown
Red-bank
Free-hold
Allenwood
Atlantic Highlands
Seabright
Long Branch
Asbury Park
Bradley Beach
Belmar
Erwinna
Quaker-town
Lambertville
Princeton
Lawrenceville
Mights-town
TRENTON
Dayles-town
Lansdale
Newtown
Bristol
Burlington
Wrightstown
Mt. Holly
Norristown
Lebanon
READING
Pottstown
HARRISBURG
Middletown
Elizabethtown
York Haven
Mt. Joy
YORK
New Oxford
Hanover
Mc Calls Ferry
Hamheim
Lititz
Reamstown
Ephrata
Brownstown
Elverson
New Holland
Leacock
Lancaster
Columbia
Downing-town
Phoenix-ville
Coates-ville
West Chester
Atglen
New Providence
Parkes-burg
PHILADELPHIA
CAMDEN
Magnolia
Woodbury
Ovid
Interlaken
Croton
Cortand
Trumansburg
Taughannock Falls
Freeville
Dryden
ITHACA
Marathon
Watkins
Millport
Whitney Point
Corning
Big Flats
ELMIRA
Chemung
Wellsburg
Endicott
Union
Binghamton
Johnson City
Maine
Deposit
Sayre
Hancock
Dalton
Norwich
Oneonta
Colliers
Bainbridge
Sydney
Walton
Gilboa
Stamford
Shandakin
Saugerties
Rhinebeck
KINGSTON
Liberty
Monticello
Mongaup Falls
Cuddeback-ville
Middletown
Port Jervis
Warwick
Tuxedo
Sussex
Suffern
Ramsey
Newton
Hibernia
Netcong
Dover
Boonton
Passaic
Rutherford
Florham Park
Paterson
Englewood
Hacken-sack
Mt. Vernon
NEWARK
JERSEY CITY
Bernards-ville
Elizabeth
Roselle
Crawford
Rahway
Plainfield
Somerville
Boundbrook
New Brunswick
Metuchen
Perth Amboy
So. Amboy
Keyport
Middletown
Red-bank
Free-hold
Allenwood
Atlantic Highlands
Seabright
Long Branch
Asbury Park
Bradley Beach
Belmar
Penargy
Stroudsburg
Delaware Water Gap
Columbia
Siegfried
Easton
Catasauqua
ALLENTOWN
Port Clinton
Hamburg
Pine Grove
Minersville
Pottsville
Frackville
Middle Creek
Williamsport
Milton
Lewisburg
Danville
Berwick
Bloomsburg
St. Johns
Freeland
Harwood
Hauto
Mauch Chunk
Sunbury
Shamokin
Mt. Carmel
Shenan-doah
Mahanoy City
Tamaqua
Lebanon
READING
Pottstown
HARRISBURG
Middletown
Elizabethtown
York Haven
Mt. Joy
YORK
New Oxford
Hanover
Mc Calls Ferry
Hamheim
Lititz
Reamstown
Ephrata
Brownstown
Elverson
New Holland
Leacock
Lancaster
Columbia
Downing-town
Phoenix-ville
Coates-ville
West Chester
Atglen
New Providence
Parkes-burg
PHILADELPHIA
CAMDEN
Magnolia
Woodbury
Lansdale
Newtown
Bristol
Burlington
Wrightstown
Mt. Holly
Norristown
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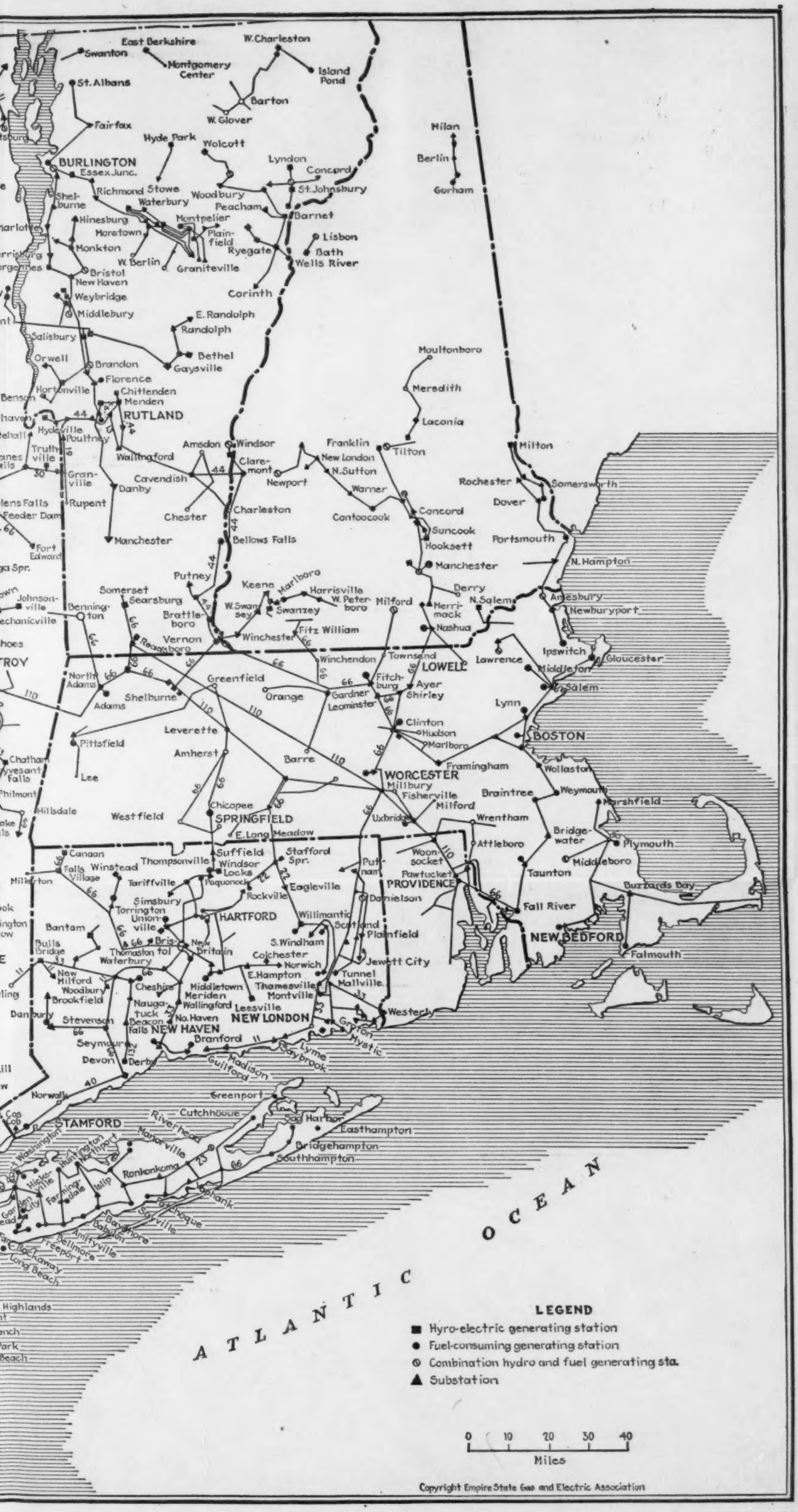

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